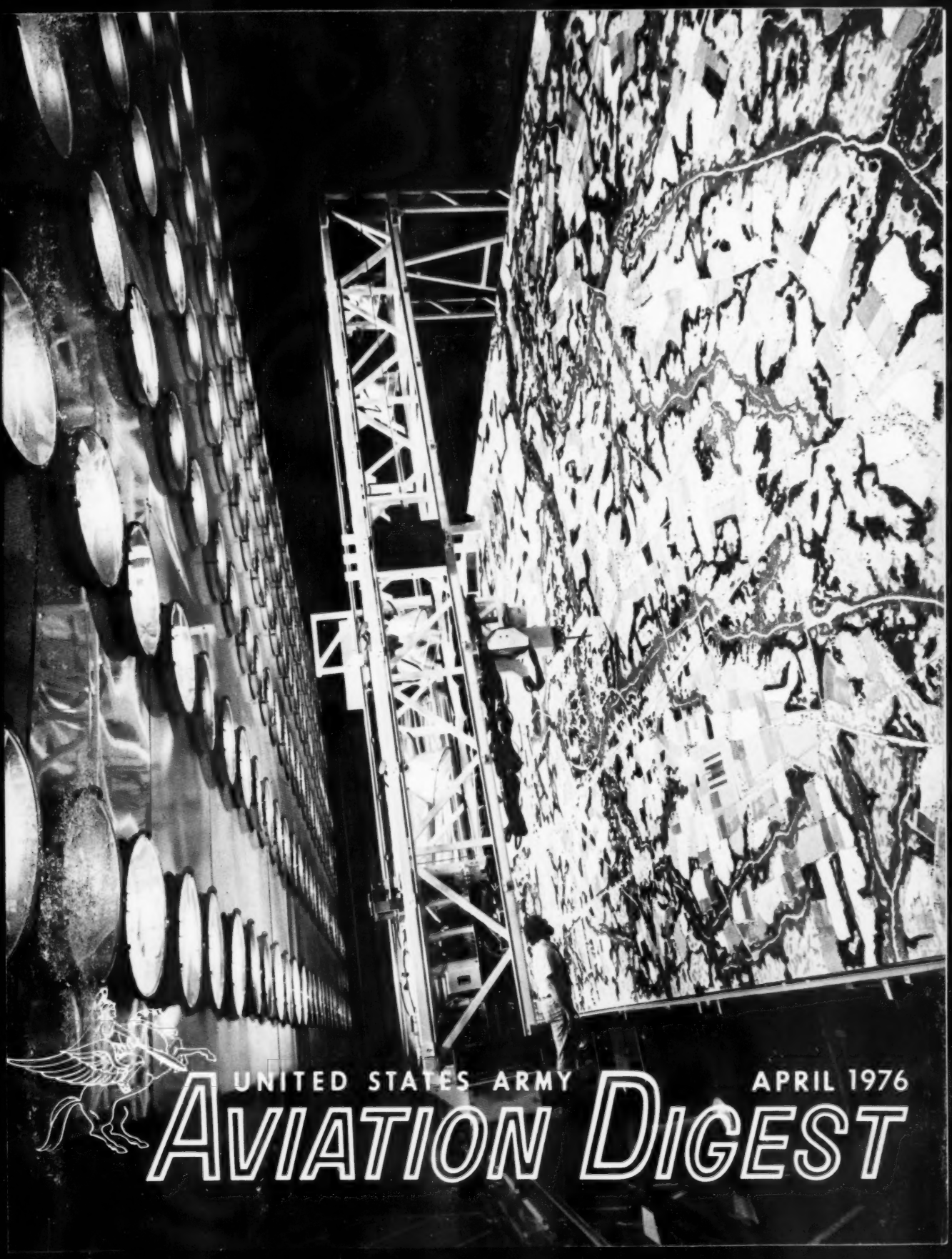

UNITED STATES ARMY

APRIL 1976

AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

APRIL 1976 VOLUME 22 NUMBER 4

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ABOUT THE COVER

The cover is a photograph of a high resolution visular system on the CH47FS showing the terrain model light bank gantry with a mounted color TV camera. It sets the SFTS — Synthetic Flight Training System — theme for this month. The DIGEST thanks the Simulation Products Division of the Singer Company for the photograph. See articles beginning on pages 1, 2, 13 and 18.

The mission of the *U.S. ARMY AVIATION DIGEST* is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine and other related data.

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Articles, photos, and items of interest on Army aviation are invited. Direct communication is authorized to: Editor, U.S. Army Aviation Digest, Fort Rucker, AL 36362.

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While SFTS *literally* will never get off the ground, the Army's Synthetic Flight Training System already is "flying high." In fact, the SFTS program is lending a big assist to refinement of Army aviation training/tactics needed to survive on the high threat battlefield and win the first battle of the next war. This is a strong SFTS endorsement, I know, and it is authoritatively supported by three fine articles in this issue of the *DIGEST*.

"SFTS, The Shape of Things To Come" begins on page 13. In this article, CW2 Tom Equels shares some SFTS background and history. He covers the status of today's simulators—and tomorrow's. CW2 Equels emphasizes that the simulators will increase combat effectiveness, cut training costs and afford us the opportunity to experiment with tactical instrument techniques.

"Tactical Training In The SFTS" by Major Elmer Curbow and MSG Tom McGuire begins on page 18. This article takes a penetrating look into how the Army's new flight simulators will involve far more people in tactical unit training, and thus help sharpen the combat effectiveness of the combined arms team. The authors envision tomorrow's simulators performing exactly as aircraft, with one small exception—flying.

When we talk of simulators—today's and tomorrow's—we should take heed of the special word *credibility* that LTC Bob Catron accents in his article "A New Approach to Flight Simulator Acceptance" (page 2). A simulator is not successful, LTC Catron stresses until the user accepts it as the *best*, saying that *"it flies like the aircraft."* The article reviews the previous program for developing and accepting the UH-1 simulator and contrasts these procedures against the new approach the Army is using to develop the CH-47 simulator. This is an approach that I highly recommend be examined as a standard method for flight simulator procurement.

This also is a good opportunity to introduce you to the new designations for the Army's flight simulators:

PREVIOUS	NEW
UH-1H (2B24)	UH1FS
CH-47 (2B31)	CH47FS
AH-1Q (2B33)	AH1FS
UTTAS (2B38)	UH60FS or UH61FS
AAH (2B40)	AH63FS or AH64FS
ASH (2B39)	ASHFS

MG WILLIAM J. MADDOX JR.
Commander
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A New Approach To

Flight Simulator Acceptance

Lieutenant Colonel Robert L. Catron, Armor
Project Director, SFTS Program
Army Training Device Agency, Orlando, FL

THE MOST important aspect of the Army's helicopter flight simulator program is *credibility*. The user must be given a system that he accepts as the best—one that he says, "flies like the aircraft."

To achieve credibility in its flight simulator program the Army has tried a new approach in establishing performance standards for its CH-47 Chinook cargo helicopter simulator. To fully appreciate the new system it first is necessary to review the previous program, specifically that which was used to develop the UH-1 Huey UH1FS (formerly 2B24) simulator. There were problems.

When the Huey simulator first hit the field, a lot of people got a wrong *first impression*. It initially didn't perform as it should. This was unfortunate because the greatest impact on the credibility of a *system*, its *developers* and its *contractors* occurs when it is delivered to the field. It is imperative that a system satisfies the users from the *beginning*.

Under the typical flight simulator program—as was used with the UH-1—definitive data completely describing an aircraft's handling characteristics under all flying conditions, throughout all flight regimes, often is not available in time for the simulator manufacturer. To understand this problem, I will briefly review the typical aircraft development program we have been using and the evolution of the data which represents the aircraft's characteristics.

Design begins with the engineer configuring the aircraft and developing a mathematical model of it. He then gathers all existing data available to support his system and modifies the data to represent the new aircraft configuration. This, then, becomes the *predicted* flight characteristics or data of the new aircraft.

The accuracy of the predicted data is improved by the next step in the development process: wind tunnel tests. Scaled models of the exact aircraft configuration are installed in wind tunnels and direct measurements of various coefficients are taken. These measurements are used to upgrade the coefficients and more accurate determinations of aircraft performance can be made.

The last step in the design process is the flight test. In an ideal flight test program—*ideal from the standpoint of the simulator user*—a fully instrumented test aircraft would be flown everywhere in its normal and abnormal flight regimes.

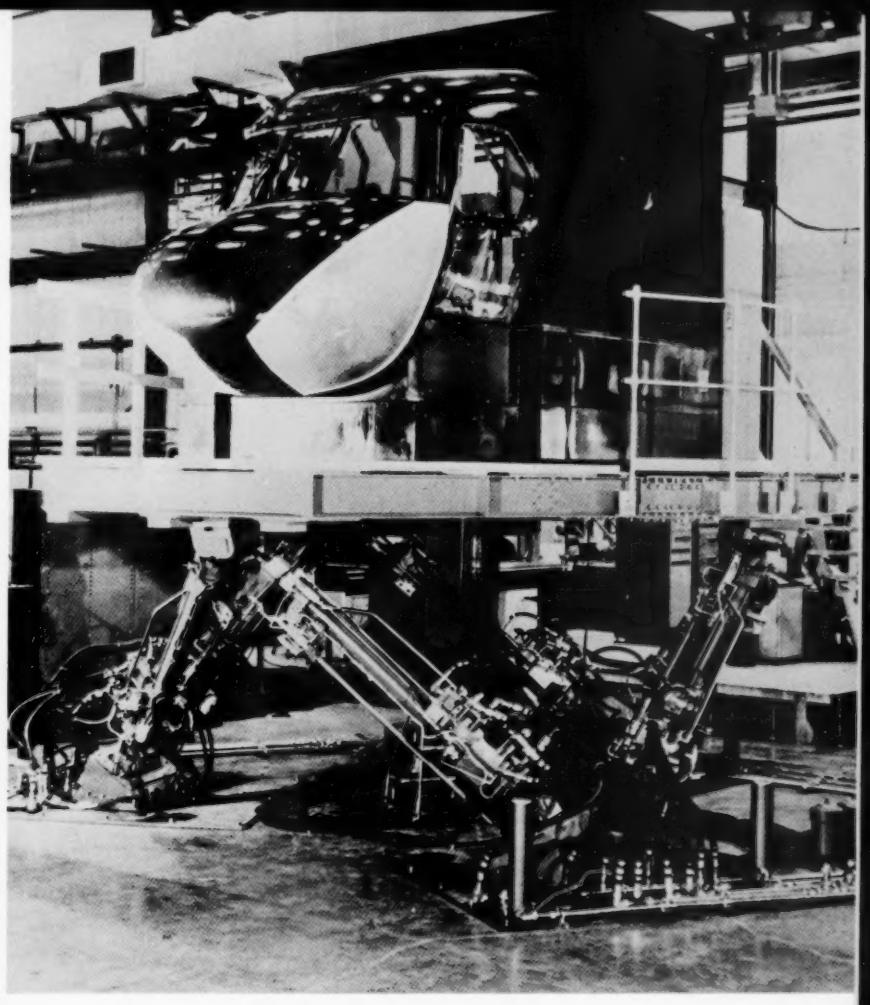
The flight test program is the most crucial step in the process of establishing data for high fidelity simulator designs. The flight data could and theoretically should serve as the standard of performance for acceptance of the simulator. The coefficient data derived from the flight test program should serve as the basis of simulator design and permit the mathematical representation of the aircraft—as implemented in the simulator—to duplicate flight test results. Our experience indicates that this ideal situation is seldom obtained in practice. Let's look at some of the reasons why not.

First, developing a precise, accurate mathematical representation of his aircraft is not a primary goal of the airframe manufacturer.

Second, even when a fairly rigorous flight test program has been conducted, it is frequently the case that there are "holes" in the data. In particular high speed lateral and rear flight, ground effect on medium and high speed flight, autoration, slope operations and malfunctions are areas where accurate flight test data normally are quite sparse.

Third, the evolutionary process which characterizes many aircraft developments often makes flight test data obsolete.

The UH-1 Huey was the first Army helicopter to be simulated. This prototype system was completed in 1972 and is in production.



The CH-47 helicopter simulator designated CH47FS. Operational flight trainer is shown without visual display installed

It is an instrument and emergency procedure trainer. The four cockpits operate on a 5-degree cascade motion base through minicomputers. These systems are operating at more than 97 percent availability today and completely duplicate the flying characteristics of the UH-1H. However, this was not always the case. We had our problems and the reputation of a fine simulator suffered. Let me describe the traditional approach the Army took in establishing aerodynamic performance and accepting the Huey simulator.

The simulator contractor had total responsibility for the acquisition of aerodynamic data. He collected the data that was available—the coefficient data from the aircraft manufacturer—tabulated the data in a criteria report and submitted it for approval to the procurement agency. The approach which was granted did not represent an endorsement of the accuracy of the data; it was, instead, an agreement that the data package submitted by the contractor was a complete compilation of all known available data. The simulator contractor then prepared the test procedures and results report. This report contained all of the test procedures and standards eventually used in evaluating and accepting the simulator.

The acceptance test procedure was developed by utilizing the coefficient data from the criteria report in off-line computer programs to compute performance and flying qualities.

The test procedures and results report also was submitted for approval by the contracting agency. Again, approval of this report did not represent user-pilot concurrence with the accuracy of the report's contents; it was an agreement that the acceptance test covered each paragraph in the trainer specification to assure that the simulator complied with the specification.

In parallel with this effort the simulator design activities continued. Trainer tolerances and curves depicting trainer performance and flying qualities were included in every simulator contract. In the case of the Huey simulator, the tolerances were written in the trainer specification. The measured trainer performance standards were not being compared against flight test data, but against standards in a test procedure report which have been based on the available coefficient data. If the coefficient data is accurate and complete, this is a satisfactory approach and the simulator will fly like the aircraft. If not, the simulator will not fly like the aircraft.

It was not until the start of the in-plant preliminary inspection that Army aviators had their first opportunity to judge how well the Huey simulator flew. The pilot evaluations during this inspection period uncovered numerous discrepancies between simulator and aircraft performance. Immediate fixes during inspection were possible in some cases; however, others which required more time for correction could not be properly addressed during the inspection period because of ready for training

Continued on page 11

This is a translation of a 3-part article that recently appeared in RED STAR. Portions of it are reprinted from TRANSLATIONS ON USSR MILITARY AFFAIRS, No. 1181, JPRS 65691 dated 16 Sep 1975

Above—Small arms land with the assault forces. Below—The self-propelled and towed version of Vulcan Air Defense System

Professor Colonel M. Belov

Doctor of Military Sciences

PART 1. Personnel and Weapons. Foreign armed forces practical experience in military organizational development attests to an increasingly intensive move toward extensive airmobility, that is, the massive adoption and diversified utilization of aircraft, technical and organizational adaptation of troops for transport by air. This objective process has . . . led to the establishment of diversified so-called vertical maneuver forces in ground forces operations: military transport and army aviation; combined units, units and subunits trained to operate as airborne assault forces; airmobile troops, organized into fundamentally new combined-arms, antitank and reconnaissance combined units and units; other air-transportable combined units and units.

The armed forces of the NATO [North Atlantic Treaty Organization] member nations are continuing to improve and perfect forces and weapons employed as assault forces as well as equipment to transport them. The composition of airborne assault forces is dictated by the quantity and quality of available airborne assault equipment — aircraft and airborne assault hardware, as well as quantity and quality of troops trained for airborne

NATO Views on Employment of Airborne Assault Forces

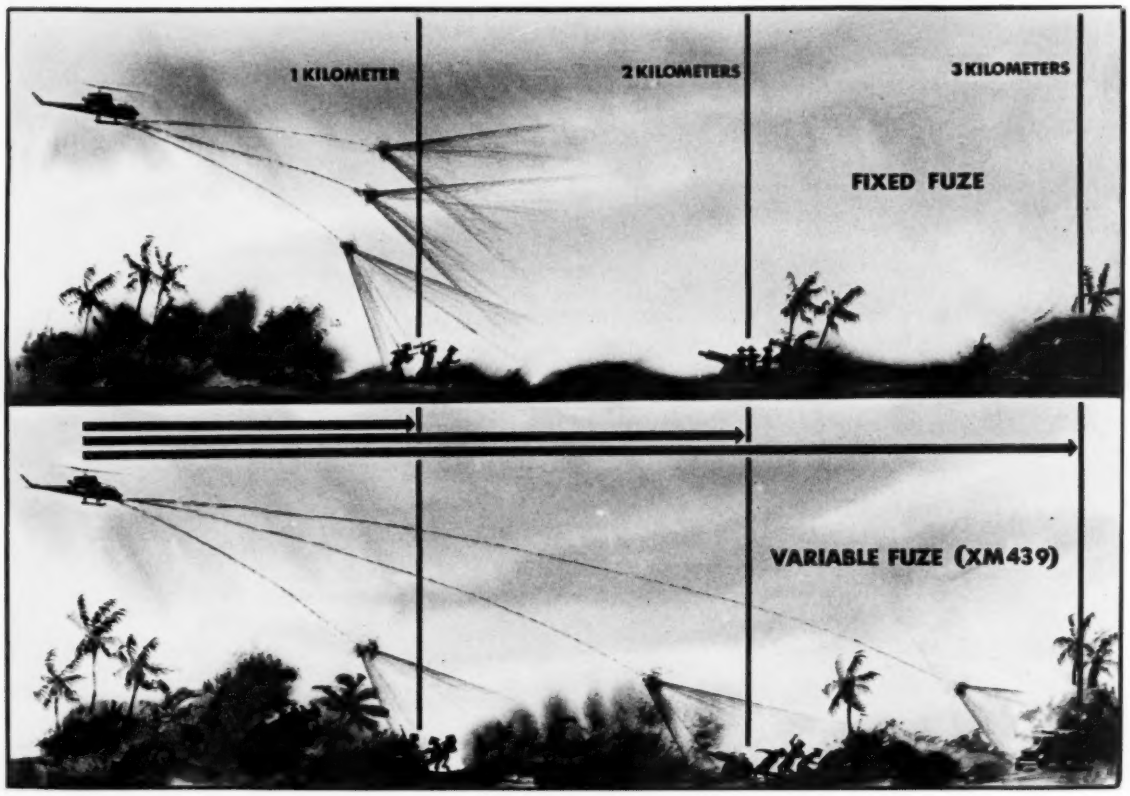
assault activities. The composition of assault forces is also determined by their function and missions.

Following World War II, helicopters began to be utilized more extensively alongside military transport aircraft for transporting airborne assault forces. These aircraft have been replaced on numerous occasions with new equipment, in conformity with technological advances and evolution of views on the nature of warfare. The load capacity, accommodation, range and speed of fixed-wing and rotary-wing aircraft have increased.

Simultaneously there has occurred improvement in airborne assault hardware, particularly means of delivery of an assault force without landing, making it possible to drop an assault force into an unimproved drop zone and at a rapid rate. For example, controllable parachutes with devices ensuring precision landing are being adopted; the result is an assault force which is quickly ready for combat. Containers have been developed and are being utilized for dropping cargo weighing more than a ton, as well as devices for free-fall dropping supplies and combat equipment from a height of 5 to 10 meters. Freight platforms and parachute systems have been designed and built which, according to the magazine *INTERAVIA*,

Continued on page 20

Above—The XR-311 "dune-buggy" with the TOW missile system.
Below—The 105 howitzer



2.75 Inch Flechette Warhead Functioning

In the past, using fixed delay fuzes, pilots were limited to one standoff distance from the target. This reduced the versatility of the flechette round. With the development of the XM-439 cockpit settable variable time delay fuze, employment distance can be selected up to 4 km without losing effectiveness. This provides rocket launch alternatives not previously available, increasing his capability to avoid enemy antiaircraft positions

Remote Set Fuzing for 2.75-INCH ROCKET

Alexander Janushevich

Fuze Development Branch
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THROUGHOUT THE course of the Southeast Asia conflict the Army attack helicopter played an increasingly important role in support of the combat arms. The 2.75 inch rocket was the most potent weapon employed by helicopter gunships. Maximum tactical effectiveness was limited, however, by lack of capability by the pilot to selectively set the fuzing function of his ordnance just prior to target engagement.

Early recognition of this problem led to the development, at Picatinny Arsenal, Dover, NJ, of a cockpit settable, multioption fuzing system which the gunship pilot can use to program variable delay after impact for unitary high explosive (HE) warheads, or timed airburst for optimum standoff of cargo type warheads (flechettes, submunitions, etc.).

A thorough evaluation of various remote set techniques was conducted, resulting in selection of an electronic, resistance capacitance (RC) time delay concept. This approach provides simple, rapid remote setting, without requiring a battery power supply in the fuze. Ruggedness and small size are other attractive features.

As a result of in-house efforts to develop a new capability for airburst fuzing for air-to-ground weapons, Picatinny Arsenal established the feasibility of using an analog electronic timer, overcoming its inherent inaccuracy with a novel technique originated by Baldwin Electronics, Inc. Laboratory analysis was confirmed in 1966 by successful field test firings.

Two 2.75 inch rocket system development programs were originally authorized: one for development of an airburst fuze, and a multioption impact time delay fuze (XM-433) for the M-151 and M-229 HE warheads. Picatinny was given complete system responsibility by the Project Manager for Aircraft Weaponization to develop, install and qualify a remote set, firing subsystem in both UH-1C Huey and AH-1G HueyCobra helicopters.

The XM-433 jungle canopy fuze and remote set subsystem was qualified, flight safety certified and successfully tested in Panama by December 1969. A quantity of these fuzes and two fully equipped Cobra helicopters were shipped to Southeast Asia (SEA) by the end of December 1969 for operation evaluation. The XM-432 was safety evaluated and further development temporarily deferred.

Following a highly successful SEA evaluation, engineering development was authorized and funded by the project manager for the 2.75 inch rocket system in late 1970 to improve producibility of the XM-433 fuze and repackage the nose mounted XM-432 in a base configuration (XM-439) for flechette warheads. Development was completed and the combined DT/OTII (developmental/operational) service use

Continued on page 26

The pilot of a Cobra attack helicopter flying nap-of-the-earth comes upon targets of opportunity very suddenly. The time available to make a decision as to the appropriate course of action is minimal. The success of the mission depends upon the capability of the system to allow the pilot to select proper functioning mode of the onboard ordnance. The XM-40 remote fuze setter subsystem and 2.75 inch rockets with XM-433E1 and XM-439 fuzes provide this capability. Upper right—HE rounds fired into a bunker with XM-433E1 fuze—set to "bunker" mode. Lower left—HE rounds fired against gun implacement—XM-433E1 fuzes set to "super quick" mode. Lower right—HE rounds fired into buildings—XM-433E1 fuzes set to "tree height" mode

NIGHT AIRCRAFT MAINTENANCE

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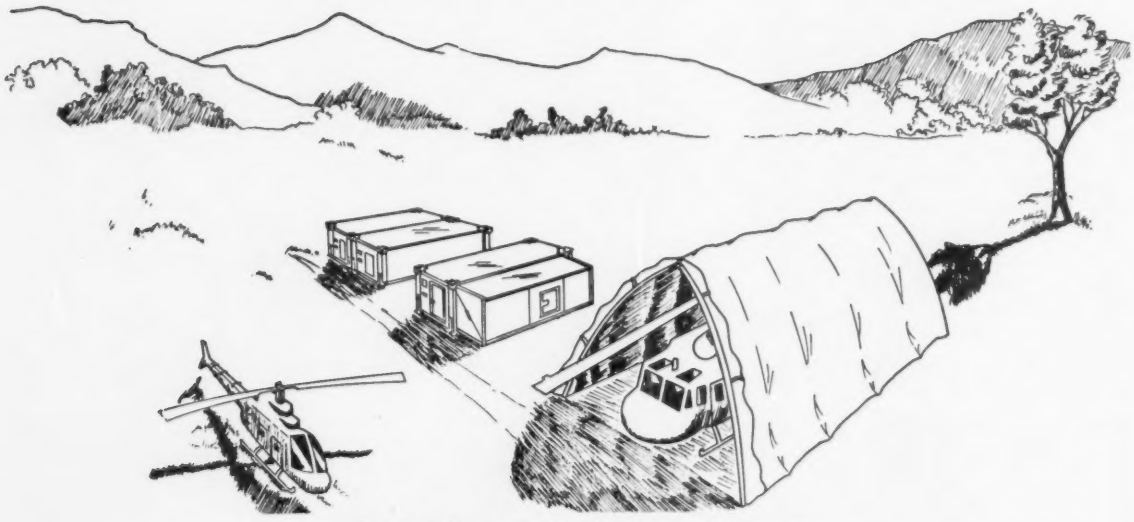


Figure 1 Transportable Helicopter Enclosure

NO ONE WHO HAS been around aviation for any length of time doubts that Army aircraft can be maintained at night. Look at our accomplishments in the Republic of Vietnam; as Lieutenant General John J. Tolson noted in his Department of the Army (DA) publication, ***Airmobility 1961-1971:*** "The maintainers achieved the miraculous. High birds in the brigade were getting 140 to 150 hours a month piled on them when they were programed for only 70, and the average UH-1 was going over 100. This overflying was in direct conflict with the desired availability rate of 75 percent, but our maintenance detachments met both goals. Crewchiefs flew all day and worked on their birds all night. The sight around the average company maintenance detachment when the birds staggered home in the evenings was a sight to behold. The maintenance crews rolled out, turned on the lights, worked with flashlights, worked by feel, worked any way, in the rain, in high winds and dust storms, all night long if necessary to patch up the aircraft, pull the required inspections, correct deficiencies and get them back on the line by the next morning. Night test flights, which are prohibited under peacetime conditions, were the rule rather than the exception."

Recall, however, that the low intensity conflict in Vietnam, with its absence of a significant enemy air or artillery threat, permitted the use of semifixed installations with well-lighted hangars and ramp space for night maintenance operations. What if the Army were facing a sophisticated enemy in the Middle East or in Central Europe and semifixed installations were not available and the use of TOE (table of organization and equipment) floodlights and light sets in the open was not permitted? Could the maintainers also achieve the miraculous

in these situations?

The answers to the above—and to many other questions—are forthcoming in the Concept of Night Aircraft Maintenance (CONAM) study. . .currently being conducted by personnel of the Army Logistics Center, Fort Lee, VA, and its associated Transportation School's Deputy Commandant for Combat and Training Developments office.

The CONAM study will determine the doctrine, organization, training and materiel requirements to support night maintenance operations in non-nuclear conventional warfare environments. During the current timeframe nature of the CONAM study, recommendations pertaining to materiel must, of necessity, address those items readily available for inclusion in unit TOE documents.

Two materiel categories have a direct bearing on night maintenance—shelters and lighting options. The Army's TOE aircraft maintenance enclosure, the 32-foot maintenance tent, is too small for most Army aircraft. This enclosure initially was designed as a medium-sized maintenance shelter for use in the repair of tracked and wheeled vehicles. AR 310-34 states, "This is a bulky item requiring considerable time to erect and disassemble. TOE proponents should use discretion in authorizing the item to units whose mission requires rapid or frequent displacement." This shelter, which has a blackout capability, will remain as the only aircraft maintenance enclosure until development and distribution of the transportation helicopter enclosure (THE) shown in figure 1 and the relocatable maintenance hangar (RMH) shown in figure 2.

Required operational capability (ROC) documents have been submitted by the Transportation School, Fort Eustis, VA, for the RMH and THE, but development is not expected until FY80. Those aircraft not protected by the current 32-foot enclosure will be exposed to the elements, which in severe environments, such as the desert or the arctic, could pose serious difficulties to an effective maintenance program.

Repair of aircraft at night outside of lightproof shelters impacts on the amount of light that units may use to effect maintenance. The obvious difference between day and night operations is the amount of light available. On the sophisticated battlefield, too much light at night could spell destruction and too little light may prevent the successful accomplishment of maintenance tasks.

How much light is adequate? No one knows for sure. However, Modern Army Selected Systems Test, Evaluation and Review (MASSTER) conducted a 7-week night aircraft maintenance exercise during November-December 1974 at Fort Hood, TX. This exercise was directed toward evaluating selected aircraft maintenance and supply functions of a typical integrated direct support maintenance (IDSM) element in a tactical night environment using various night lighting options (TOE lighting, chemiluminescent lights, head lantern and the AN/PVS-5 night vision goggle). The exercise determined which night lighting option now available to the Army permits the highest degree of production and quality with the lowest degree of signature and vulnerability. The exercise also gave maintenance planners a handle on the degree of degradation in productivity when working at night. Currently, doctrine acknowledges this degradation but does not stipulate what it may be. This is because the maintenance request (DA Form 2407) does not separate the manhours expended into day and night maintenance task accomplishments.

Training, both individual and unit, appears to offer the greatest opportunity for improvement in the

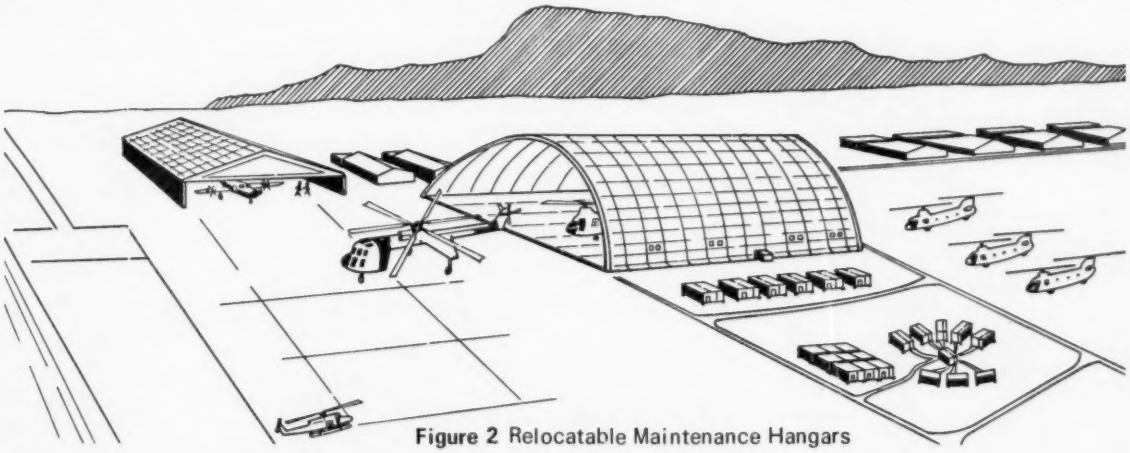


Figure 2 Relocatable Maintenance Hangars

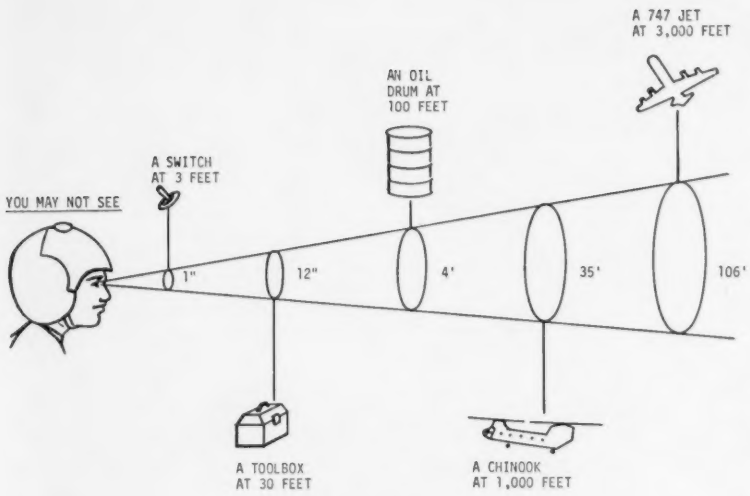


Figure 3 Night Vision Hazards

shortest period of time. But, night maintenance training is totally inadequate. Not only is there no hands-on night maintenance training in our service schools today, but also Army training tests (ATTs) and field exercises usually are of such short duration that units rarely are required to perform night maintenance under field conditions. Aircraft capable of being repaired in the field often are flown to the unit's fixed base hangar facilities for repair.

The Army has been emphasizing night tactical operations at the U. S. Army Aviation Center; MASSTER; and the Combat Developments Experimentation Command, Fort Ord, CA. But up to this point there has been no similar emphasis on night logistical operations.

Training for night maintenance operations requires more than turning off the lights. Personnel must be shown the different techniques to use at night. This includes instruction and practical demonstrations on the loss of depth and color perceptions, as well as the loss of the cones in the eye which results in a night blind spot. This night blind spot creates severe safety hazards (figure 3) unless personnel are intensively trained in the proper way to see at night. Individual and unit confidence in the ability to function at night can be built up only after extensive periods of night training. As the then Brigadier General George P. Seneff Jr. said in 1965, "The only way to get good at operating in the dark is to go out and operate in the dark. The best approach is to reverse the training day for concentrated periods from time to time."

Many aviators and aircraft maintenance personnel may wonder why the Army must have a night maintenance capability. The answer is that maintenance requirements in a conventional conflict environment against an enemy that possesses considerable air, missile and sensor capabilities will increase dramatically over what we experienced in Vietnam. In order to maintain aircraft availability rates at or above DA standards, aviation and aircraft maintenance units probably will find themselves working day and night.

Another reason for night maintenance will be the mobility requirements of future conflicts. Unlike Vietnam, in which Army aviation operated from enclaves, conventional conflicts will require a much higher reliance on base camp mobility to avert destruction.

The doctrine of our potential enemies emphasizes continuous operations, and they practice what they preach.

Several corrective actions are readily available as documented and recommended in CONAM:

First, require that aviation-related officer and enlisted personnel be intensively trained at Army service schools in both night logistical operations (in both garrison and field environments) and in camouflage and deception techniques.

Second, require that aviation-related units intensively train at night in field environments that require camouflage and dispersion.

Third, provide a wartime second shift augmentation of personnel to aircraft maintenance units' TOEs.

Fourth, equip helicopter crewchiefs, maintenance contact teams and aerial recovery personnel with the AN/PVS-5 night vision goggles (since it's the best currently available).

Fifth, equip remaining personnel with battery-operated electric head lanterns (unit cost: $6.49) fitted with red or green filters.

Sixth, the development of individual aircraft enclosures which provide environmental, camouflage, anti-infrared and lightproof protection features needs to be initiated. In addition, shop shelters which are highly mobile and of standard configuration need to be fielded.

The U. S. Army has a long way to go before it will be able to operate logistically in an effective manner at night. The implementation of these few recommendations should give the Army aviation community a baseline from which improvements can be rapidly made.

Flight Simulator Acceptance

Continued from page 3

dates and contractual considerations.

Many problems dealing with performance were uncovered during acceptance of the trainer. Keep in mind the contractor held up his part of the deal—he met the specifications and conformed to the data that was supplied to him. The data was just not good enough for a simulator. All Huey simulator discrepancies have been corrected.

The unfortunate part was *credibility*. It has taken years for the system to be fully accepted—and there are still some people who feel it "doesn't fly like the aircraft." So, *credibility* looms as a major factor in the "new" approach to establishing performance standards for the CH-47 simulator.

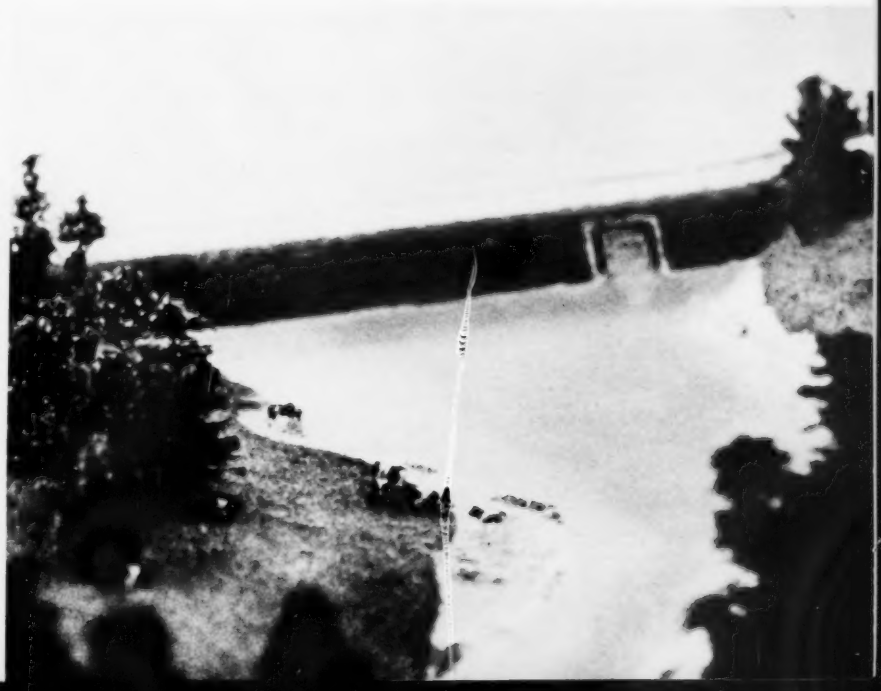
This trainer simulates all flight and hover dynamics of the CH-47 helicopter. It is the first helicopter simulator with a visual system and the first simulator to the best of our knowledge to employ this new approach to establishing performance.

Let me describe what I believe to be a greatly improved procedure: the *simulator contractor* still had the initial responsibility for *the acquisition of aerodynamic data.* He still collected this data and incorporated it in the *criteria report,* which was submitted to the Government for approval. He still proceeded with *simulator design based on the data in the criteria report.*

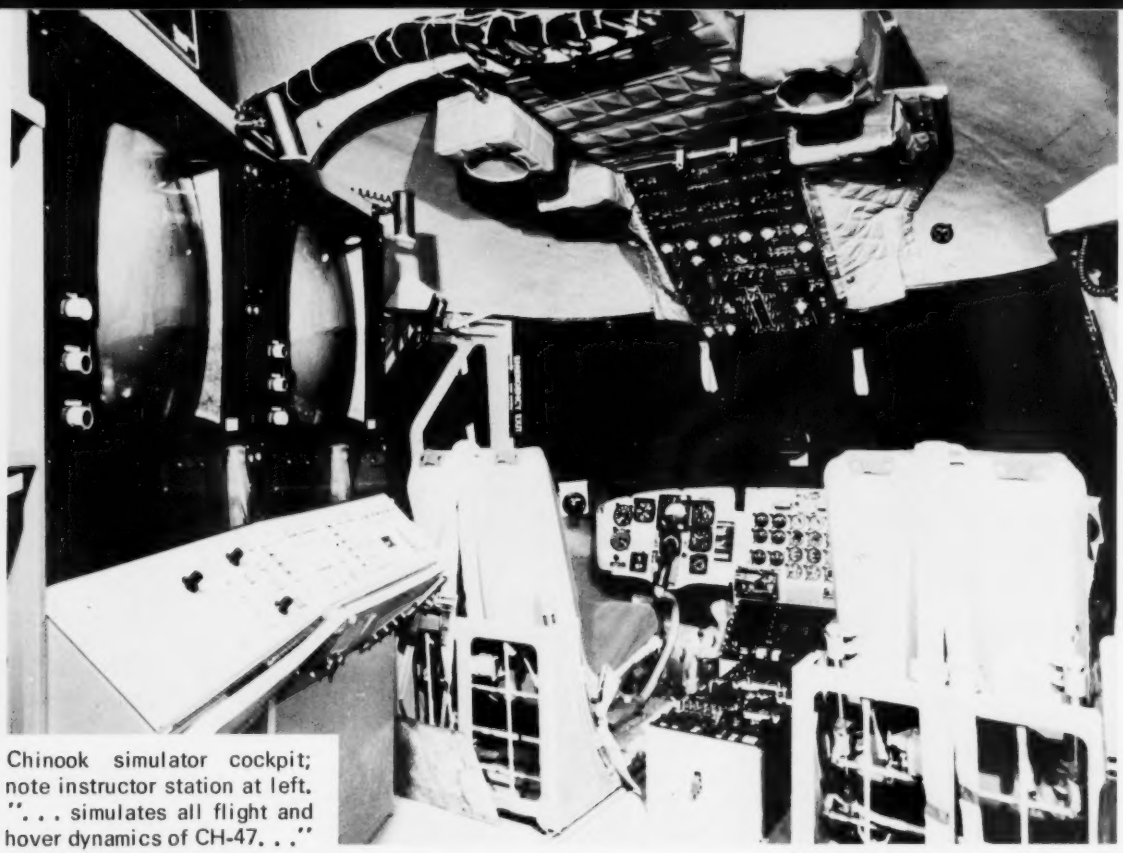
But, here the Army's new procedure departed from the old. *First,* the Army established a pilot evaluation team to provide preliminary evaluations of the trainer performance *prior* to the start of formal acceptance testing. Each phase was a joint, constructive work session. The participants were two Army aviators, the NTEC (Naval Training Equipment Center) project engineer, and the contractor design engineers. In the first phase, gross flight handling and steady-state performance discrepancies were noted by the pilots. Discrepancy reports (DRs) were written and worked out by the participants. The second and third sessions were quite similar. Old DRs were re-evaluated; new DRs were written; both old and new DRs were jointly worked on, corrected and approved. By the end of the second session the simulator was flying very much like the aircraft and the team's efforts were starting to concentrate on the more subtle aspects of handling qualities. By the end of the third session, the pilots were unable to identify any significant discrepancies between the simulator and the aircraft performance and flying qualities. At least one different pilot was used during each of these evaluations.

The *second* departure from the old procedure had to do with flight time for contractor engineering personnel. At the beginning of the program, *contractor personnel* went along on routine CH-47 training flights for orientation purposes. The trips included discussions between Army instructor pilots and contractor personnel about aircraft flying qualities, pilot techniques, sounds, malfunctions and manuals.

The *third* departure from the older procedure was related to the test procedures and results report. This report, as indicated earlier, normally had been based on original coefficient data. This same procedure was followed initially on the Chinook simulator program, except that the quantity of test conditions was kept relatively small. This limited test procedure was then used by the contractor for internal test purposes prior to the first evaluation phase. Changes in simulator performance could only be achieved by modifying the original coefficient data stored in the simulator computer. That is, the tailoring process instigated by the evaluation team dictated changes in simulator performance which required changes at the aerodynamic coefficient level.



Example of the visual display used with this simulator. Model board adds to training realism



Chinook simulator cockpit; note instructor station at left. ". . . simulates all flight and hover dynamics of CH-47. . ."

The resulting coefficients differed substantially from those originally supplied to, and utilized by, the simulator contractor.

Under these circumstances, it is obvious that a test procedure report based on the original coefficients had no meaning. In our new procedure, therefore, the results of the evaluation phases—as measured on the simulator—were incorporated into the appropriate sections of the test procedures report, since those results represented our best determination of performance and flying qualities.

The Chinook simulator's initial design was based on coefficient data supplied by the aircraft manufacturer and supplemented by the simulator manufacturer in areas of missing data. Using this initial data base, the simulator was flyable but only marginally stable. These changes had to be made:

- Longitudinal and directional sensitivity
- Angle of attack and speed stability plus positive stick gradient
- Trim long stick position as a function of airspeed
- Adjustments to match dash 10 (Operator's Manual) hover, speed and climb performance
- Coordinated turns with lateral stick only
- Two wheel taxi with proper control application
- Autorotational flying qualities
- Acceleration and deceleration characteristics
- Collective pitch on rate of climb

Keep in mind that we are simulating the C model Chinook. It comes as no surprise that we had to make changes in the data stored in the simulator computer. All these discrepancies have been corrected.

As a result of the Chinook simulator approach to trainer acceptance, we have a cost effective simulator that will enhance the Army's flight training program.

RESULTS OF CH47FS APPROACH

- **A fully accepted trainer by Fort Rucker instructor pilots**
- **A high fidelity simulator that–"flies like the aircraft"**
- **A simulator that will be presented to the user with a high degree of confidence that it will do the job**
- **No expensive or time consuming TCPs**

ANNUAL AWARD
Monthly Winner
CONTEST

SFTS:

the shape of things to come

CW2 Thomas K. Equels
Project Officer
U. S. Army TRADOC Aviation Study Group
U. S. Army Aviation Center

IN JUNE OF 1973 I was a fresh graduate of the instrument instructor pilots course at the U. S. Army Aviation Center. Eager to pick up my first students and begin training, I received orders that, at the time, disappointed me. I was to report to Pratt Hall, on Fort Rucker, for a 1-week instructor transition into the Synthetic Flight Training System (SFTS). Immediately I conjured up visions of a "blue canoe"—the 1CA1 synthetic instrument trainer (Link). [See "The Missing Link," January 1961 ***DIGEST***.]

When I arrived at Pratt Hall, I was pleasantly surprised. Far from being a replica of the "blue box," the SFTS was a massive and complex conglomeration of cockpits, computers, consoles, ladders, lines and lights. The gargantuan size and apparent complexity of the SFTS prototype initially made me apprehensive, and to a degree, doubtful of its operational capabilities. After about 1,000 hours of instructor experience in the system, any doubts I once harbored had been allayed. I would like to share the benefits of this experience and research into the system with you, for in my opinion, simulation is the shape of things to come.

The SFTS can trace its ancestry back to the original Link flight trainer built in 1929. The state-of-the-art has slowly made progress, gradually becoming more complex and realistic. The development of advanced computer systems gave the necessary impetus for rapid growth and development resulting in the present SFTS. The UH1FS (formerly called the 2B24), the designated nomenclature of the UH-1H simulator, sets a worldwide standard in helicopter simulation. It provides such a high degree of realism and efficiency that simulator training is not only feasible, it also is *preferable*. The UH1FS mirrors the cockpit environment, mechanical and flight characteristics, and operational environment of a UH-1H in instrument conditions. The system operates with such a high degree of exactitude that successful initial entry, transitional and proficiency training can be accomplished with ease.

There are many advantages in using simulation as a training media. Simulation provides high quality training that is economical. The average cost of 1 hour of UH-1H flight training is about $250. Compare this to the approximate cost of $65 cost per hour of the UH1FS and the system virtually pays for itself. The system is nonpolluting, unlike the aircraft, and reduces the military demand for petroleum-based fuels. The simulator provides a degree of dependability unobtainable in the actual aircraft.

Training availability is not affected by refueling,

The young lady pictured above is Jennifer Waldmann. Our thanks to her uncle, LT Reid Aaron, for sending us Jennifer's picture

time, adverse meteorological conditions or extensive periodic maintenance. The instructor also has a great benefit in being able to control environmental conditions. By pressing a button the instructor pilot can change the turbulence level, wind velocity, wind direction, barometric pressure, temperature, and he also can induce ice accumulation. At the instructor's discretion, singular or multiple aircraft malfunctions can be produced with complete safety.

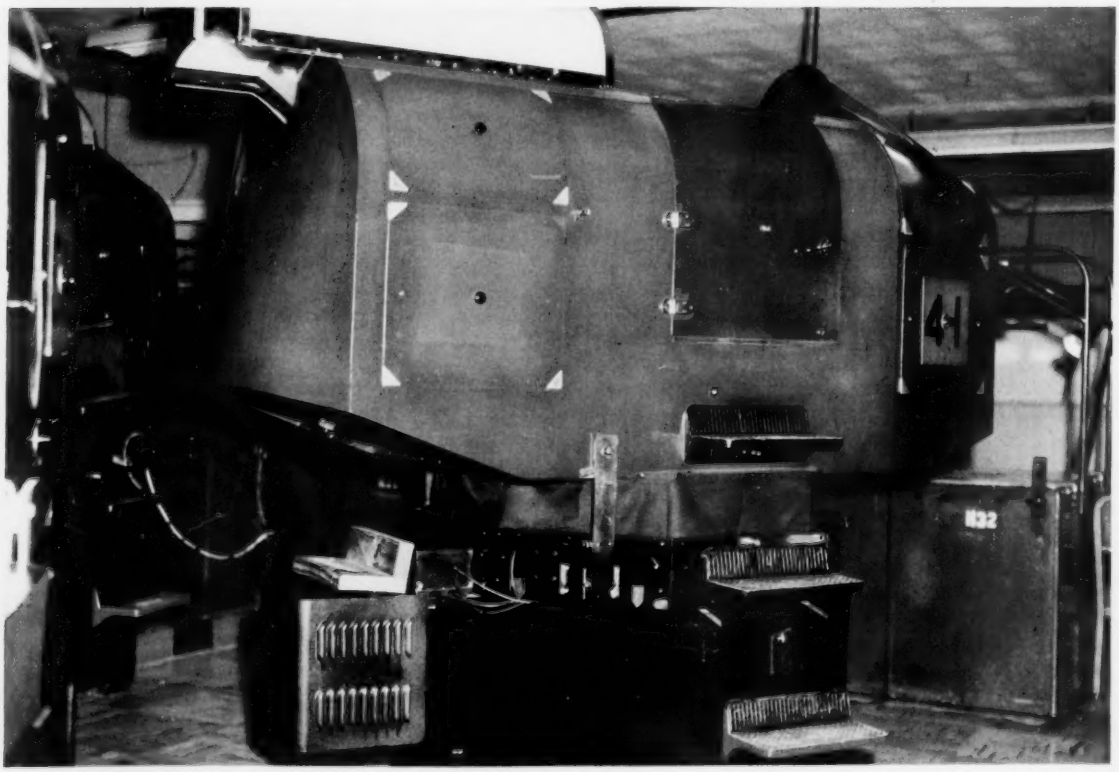
The UH1FS can be programed with five malfunctions at once. And, there are 104 realistic emergencies from which to choose. This provides for essential training in that many of these malfunctions could not be demonstrated in flight due to the great risk involved. The system also provides a great deal of flexibility for the instructor who can freeze the training environment and repeat the lesson for reinforcement of a problem.

The CRT, a cathode ray tube located in the cockpit, provides a visable readout on ground track, airspeed, altitude and indicates points where the student exceeds flight parameters. The advantages in the areas of safety, flexibility, control, dependability and economy should have a great impact on our future training environment.

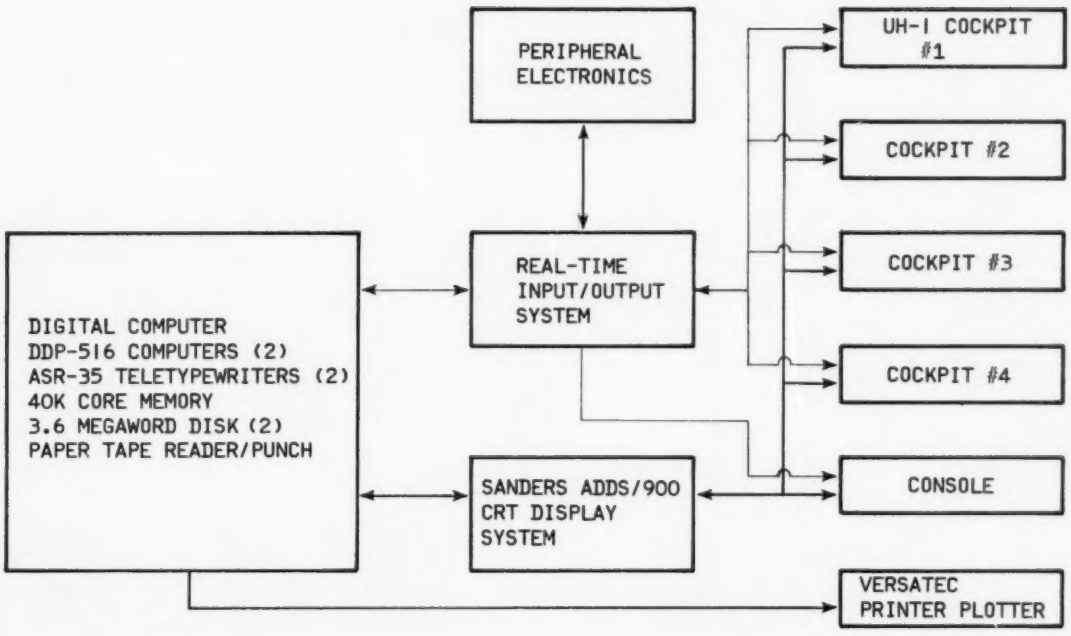
The UH1FS is the only simulator now operational in the U. S. Army inventory. Each UH1FS system consists of a complex of four simulated cockpits, the communal brain being a hybrid digital analog computer system. Each of the cockpits has five axes of motion. The following simultaneous motion capabilities are provided: pitch, roll, yaw, vertical translation and lateral translation.

The motion systems are driven by their own hydraulic power source under a pressure of 1,500 psi (pounds per square inch). The motion of the cockpit occurs along realistic aircraft body axes and imparts proprioceptive cues that detail the sensations experienced in normal and abnormal flight conditions. The hybrid digital analog computer complex is the relay that translates cockpit cues into hydraulic action. The basic characteristics of the system are as follows: sound and motion; flight control response through 5 degrees of motion; digital computer system; more than 100 radio navigational aids; complete control of meteorological environment; control of aircraft

The 1CA1 Link "Blue Canoe"



UH1FS
SYSTEM DIAGRAM



malfunctions; control of weight and balance; ground track display; 5-minute action playback capability; freeze capability; utilization of UH-1H cockpit interior; and the aircraft is always in instrument meteorological conditions. This basic description is further supplemented by the accompanying diagram.

The delivery of SFTS UH1FS devices to installations outside of Fort Rucker is underway. The Aviation Center has six devices, or 24 cockpits. Fort Campbell, KY, received one device in March 1975. USAREUR (United States Army Europe) received a device in July 1975 and located it at Hanau, Germany. Proposed locations for devices in 1976 are Fort Lewis, WA; Hawaii; Fort Stewart, GA; and Fort Bragg, NC, in that order. Fort Hood, TX; Fort Riley, KA; Fort Knox, KY; Korea; Indiantown Gap, PA; and Fort Benning, GA, will receive their UH-1 flight simulator in 1977. The UH1FS will be used primarily for instrument refresher and combat readiness training at these sites.

The UH1FS system can measurably increase the combat effectiveness of certain combat ready aviation units, especially strategic alert units. It can adjust its 256-square mile gaming area (training area) to suit any geographical location. The computer system can realistically duplicate any area to include elevations and establish navigational aids. Tactical beacons also can be simulated with precision. The system can duplicate airdrops of portable beacons and do so in a time sequence. Tactical NDB (nondirectional beacon) or GCA (ground controlled approach) into temporary airfields can be simulated with ease.

This capability gives a great deal of flexibility in the testing of contingency plans that require IFR (instrument flight rules) flight. The commander can ensure that his aviators are familiar with proposed contingency areas, and are able to react effectively when the plan is actually put into effect.

The simulator also allows aviators to experiment with tactical instrument techniques. Instrument flight as low as 200 feet can be practiced—and in a safe manner. Testing of tactical techniques can be made at a lower cost and smaller risk factor. Radar altimeter systems and new navigational equipment developed for the tactical atmosphere can first be tested in the SFTS.

The effectiveness of the UH1FS as a primary usage instrument trainer has been proven through its success in initial entry instrument training. Statistically the students trained in the SFTS environment are equal to, or slightly better than, previous trainees not receiving the benefits of simulator training. To exemplify this point some statistics compiled by the Human Resources Research Organization prove interesting. An experimental group of 16 students in the U. S. Army Aviation Center's Officer Rotary Wing Aviator Course was randomly selected. They had no previous instrument flight experience; however, all had previous flight experience.

The experimental group received all instrument instruction in the UH1FS with a short (averaging 4 hours) transition into the actual aircraft. The results are as follows: mean average of individual training time was 44 hours and 12 minutes; mean checkride time was 2 hours and 15 minutes; total flight time in the instrument phase was 46 hours and 55 minutes; the checkride average was 82 with a high of 90 and low of 70.

All test subjects were passed with only one requiring a reexamination, which was successful. The results clearly indicate that the simulator can be beneficial in obtaining standard instrument rating proficiency.

The future holds a great deal in store for simulation in Army aviation. SFTS simulators now under development are: CH-47C operational flight trainer CH47FS (2B31); AH-1Q operational flight trainer AH1FS (2B33); advanced attack helicopter (AAH) operational flight trainer; and the utility tactical transport aircraft system (UTTAS). The development of the CH47FS and AH1FS devices has passed the planning stage and is expected to be operational in 1976. The AAH and UTTAS are still in the concept phase of development.

The simulators duplicating the CH-47C and AH-1Q are scheduled to be flying this August. However, they will not be moved to Fort Rucker until the building to house them is completed. Similar devices will be going to the field in the future if all goes well. The interesting point about the CH47FS and AH1FS is that they are operational trainers, and the pilots fly from visual cues. Simulation has left the "blue box" far behind.

The CH47FS trainer has a simulated CH-47C cockpit containing authentic replicas of the pilot and copilot stations. As in the UH1FS, as much original equipment as possible is used. The system is on a 6-degree-of-freedom cockpit motion system that provides the standard motion sensations plus acceleration-deceleration effect and a hover sensation. The CH47FS has a visual system that consists of: a camera-model image generation system; synthetic terrain and ground symbol generator; and an infinite

Instrument Training Program Goals

Program	Goal	Cost
Step 1	SFTS 7.5 hrs	$ 286.50
	UH-1 42.5 hrs	10,115.00
	Total 50.0 hrs	10,401.50
	Savings per student	1,785.00
Step 2	SFTS 20 hrs	764.00
	UH-1 30 hrs	7,140.00
	Total 50 hrs	7,904.00
	Savings per student	3,996.00
Optimum	SFTS 40 hrs	1,528.00
	UH-1 20 hrs	4,760.00
	Total 60 hrs	6,288.00
	Savings	5,612.00

image display system mounted in the cockpit. The CH47FS uses a digital computation system and the motion systems are driven by hydraulic pumps. The CH47FS has the capability of programing 200 different malfunctions and these are precisely duplicated to allow training in malfunctions ranging from a generator failure to hydraulics-off flight.

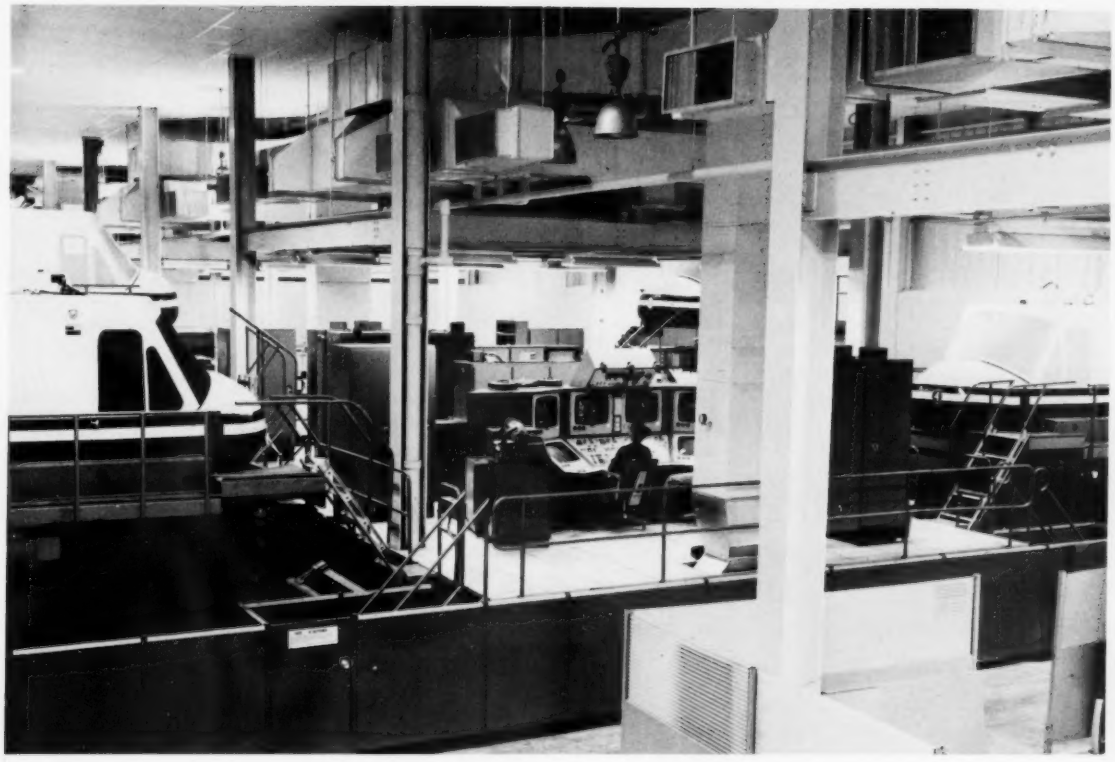
The AH1FS system can be used for both transition and weapons training. The system has two separate cockpits, one for the pilot and the other for the copilot/gunner. Both of these are driven by the same digital computer complex. Both cockpits operate on independent six axes motion systems. Visual display systems are contained in each cockpit to provide realistic visual simulation. The two cockpits can be used for independent crew training or for integrated systems training, at the discretion of the instructor pilot.

The visual system was of particular interest to me in that the visual simulation must be adequate enough for the pilot to control the aircraft in all six axes of motion. The basic system, for both CH47FS and AH1FS, consists of terrain display boards; a television camera gantry system; closed circuit television electronics; and related image processing circuitry.

The CH47FS provides both forward window and chin bubble visual displays for pilot and copilot. Its terrain boards have two scales, 400:1 or 1,500:1, depending on the aircraft maneuvers that are desired to be taught.

People who have viewed demonstrations of the visual system commented that the 400:1 scale was excellent and very realistic and the 1,500:1 scale was satisfactory.

The AH1FS provides forward display in the



The UH1FS Synthetic Flight Training System

copilot/gunner cockpit. The pilot has forward and left displays. A symbolic display exists for the telescopic sighting unit (TSU). The AH1FS terrain board has only one scale, 1,500:1.

The AH1FS can simulate most visual flight maneuvers and weapons exercises. The instructor can program 140 malfunctions, giving essential training in weapons systems malfunctions and other hazardous in-flight emergency procedures. Some of the visual maneuvers are low level autorotation, steep dives, forced landing on takeoff and a wide range of less exotic maneuvers.

The weapons systems will be integrated through the computer to the camera-model. The system provides the visual scene, targets, visual trajectory information, simulation of the 7.62 mm minigun and 40 mm cannon, the TOW (tube-launched, optically-tracked, wire-guided) systems are also simulated, and there is simulation of impact and detonation. The weapons subsystem can even duplicate tracer fire and the weapons malfunctions range from hang fires to circuit breaker malfunctions.

The use of sophisticated simulators as a training vehicle is the wave of the future. The adjustments in the initial entry instrument program since UH1FS acquisition is evidence of this trend. Initial entry rotary wing (IERW) program goals that now are being put into effect are in the figure on page 16.

The savings realized through use of SFTS can amortize the initial investment cost of the system in just a few years.

It is clear that military aviation can make much more extensive use of the SFTS in initial entry, combat readiness training and transitional training. Army aviation is progressing toward successful use of simulator systems. Army aviators should find the SFTS invaluable as an instrument proficiency trainer, and as the aviator becomes familiar with simulator systems a greater appreciation will develop. The long-range plan is for SFTS to include a simulator subsystem for each of the helicopters in the expected Army inventory. In future days of escalated flight costs the simulator will become a way of life for the military pilot.

Tactical Training in the SFTS

Major Elmer E. Curbow
Chief, SFTS Branch

MSG Thomas McGuire
Chief Instructor, SFTS Branch

Department of Academic Training
U. S. Army Aviation Center

THE CONCEPT OF teaching students to fly instruments in a helicopter without getting off the ground is a daily routine at the United States Army Aviation Center's Pratt Hall. That concept now is beginning to expand and will have a tremendous impact on pilot training as Army aviation's role on the high threat battlefield takes on newer and more challenging responsibilities.

Army aviation is engaged in a continuing battle to move troops, materiel, and furnish firepower faster and in larger quantities than ever before—regardless of terrain, weather conditions or enemy capabilities. This requires a technology of the highest order. However, technology capable of developing the aviator tactics and hardware necessary to win in the high threat environment costs money, time and sometimes lives. One can readily visualize that the total effort needed to attain such a state of readiness will be indeed a most expensive venture. The construction, development and operation of such complex systems cannot be entrusted to men that are not proficient and adequately trained.

As in almost any endeavor, the progress and success of Army aviation rests heavily on the training and proficiency of its people. It is to this end that the field of flight simulation strives. Whether the aviator of the future is operating in a tactical exercise, nap-of-the-earth maneuver or a high threat environment, his level of proficiency and success will be influenced and determined largely by the training received in the "birds that never fly."

The value of simulation is virtually immeasurable and all encompassing. In civilian industry, aircraft are being designed, "flown" and redesigned through the use of simulators and computers before the first weld joint is made. In the Army, new ideas, tactics, concepts, maneuvers, tests and evaluations can be tried with a high degree of accuracy in the accident-safe simulator. When the cost of a single helicopter such as a UH-1H Huey, CH-47 Chinook or AH-1 HueyCobra is contemplated, it readily can be seen that simulation is one of the greatest, most cost effective-cost reduction processes being used today.

The use of simulation in support of student training at the Aviation Center has many advantages. To start with, the simulators allow for a much greater degree of flexibility in employing the existing helicopters in the Army inventory. Approximately 50 additional helicopters would have been needed to fly the same number of hours that were flown in the UH1FS (formerly 2B24) simulator last year. However, thanks to the UH1FS, that's 50 helicopters the Army can use to bolster its combat power. Also, it's 50 fewer helicopters in the training fleet which means the Aviation Center can have more space on its airfields; less extensive ground support facilities; and decreased airspace congestion. There is another big "plus." Under a mobilization type training schedule, the number of hours flown in the UH1FS last year could be doubled, thereby replacing about 100 aircraft instead of 50.

Synthetic Flight Training Systems (SFTS) are now in the process of being sent worldwide to all areas where sufficient training requirements exist. Some of the advantages of using the UH1FS at the Aviation Center already have been discussed. Most of these also apply at field sites. Then, there is another advantage that the UH1FS affords tactical units at field sites. History has shown that *unit training, individual proficiency, materiel readiness* and the *teamwork of the combined arms team* are critical *attributes* in winning the first battle of the next war. The UH1FS can and will play a major role in developing and maintaining each of these attributes.

The first and last *attributes* mentioned—*unit training and teamwork of the combined arms team*—are closely related. By using the capabilities of the UH1FS, far more people can be involved (trained) in employing the overall coordinated efforts of the entire team. The complexities of command post exercises (CPX) now can be expanded to include and better train more members of the team. For example, when a division receives a CPX mission, air traffic control (ATC) personnel are brought directly into the play of the exer-

cise. The ATC unit brings the corps tactical airway system to the division and then through a detailed map analysis, and in coordination with the other staff sections, the division tactical airway system is constructed. This tactical airway system goes down to and includes the instrumented brigade airstrip. Thus far the ATC unit and the ground units are interacting (training) just as they would in a real combat situation.

At this point, the tactical airway system is programed into the UH1FS computer. As the CPX continues, requests for air support are processed through actual channels such as S-2/G-2 air or S-3/G-3 air; through the division aviation office; and down to the aviation unit. At the unit level the operations office schedules the "aircraft" (UH1FS) and crew. The crewmen are briefed on their mission and then they plan and fly it.

To add even more realism to the problem, the real world (CPX) environment can be built into the situation. The crew comes up with its loading plan and computes the actual gross weight, center of gravity, fuel requirements, power requirements, anticipated performance, etc. The temperature, altitude, wind, turbulence, etc. can be quickly changed to fit any given situation. After this real world planning, the crew flies via the tactical airway system to the brigade forward airstrip and shoots an ADF (automatic direction finder) approach. It then reports to the brigade commander that his aerial resupply has been affected and returns to the division airstrip, shooting a GCA (ground controlled approach) or perhaps continuing to another forward airstrip as required by the mission.

To enhance the overall team effort, all friendly and enemy indirect fire and direct air support is plotted as required. Since the exact position of the UH1FS aircraft is always known, the effect of the friendly artillery fire upon the aircraft is analyzed to see if proper coordination has been conducted.

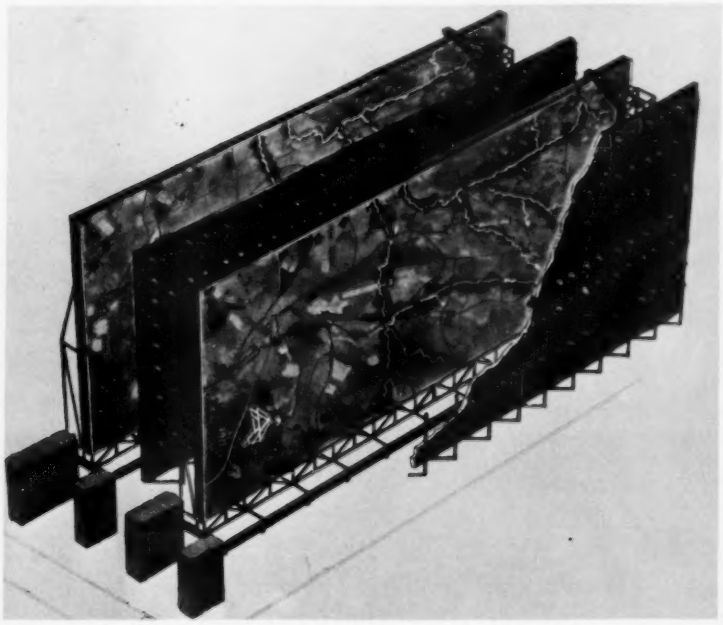
In this one simple example, almost everybody directly or indirectly related to aviation support is required to perform his mission. The unit training is enhanced, individual proficiency is improved, the overall team effort of the combined arms team is exercised, and lastly, since the entire mission is conducted in a UH1FS, the actual aircraft are undergoing required maintenance, thereby improving the materiel readiness posture of the unit.

Truly, it seems that the only limitation on the SFTS is the imagination of the user. And, since Army aviators are noted for their open-mindedness and innovative thinking, new ideas for using the capabilities of the SFTS are coming in on a nearly routine basis.

Future simulators will add more sophistication to the devices and result in increased training benefits. Innovations that are in the offing include such features as a camera model/terrain board visual system; computer generated imagery; integration of aircraft simulators with weapon systems replete with simulated enemy ground fire and air-to-air combat; formation flight training; simulated high threat environment and counter techniques; and interfacing the heavy lift helicopter, advanced scout helicopter, utility tactical transport aircraft system and advanced attack helicopter to allow simultaneous simulation that will provide concerted training in coordinating and conducting an air assault exercise.

Thanks to simulators, Army aviators soon will have at their fingertips training capabilities not even dreamed possible a few years ago. Yes, in the simulators of tomorrow, aviators will be able to perform everything that is possible in the aircraft and then some—with one small exception—actually fly.

Tactical training in simulators acquires realism through terrain mockup which the trainee "overflies"



NATO Views

Continued from page 5

make it possible to drop from aircraft combat equipment and supplies weighing more than 20 tons.

A control entity for the U.S. XVIII Airborne Corps has been established for the purpose of directing the combat operations of a large airborne assault force. In peacetime it deals primarily with the combat training of airborne troops, which presently include the 82nd Airborne Division and three special airborne groups. U.S. military leaders are working on delivery without landing of a full airborne division, while working in parallel on an airborne assault operation involving landing the aircraft. The division's combat capabilities are being improved in such basic components as firepower (particularly against tanks and air targets), mobility and survivability, and striking power.

Organic to the U.S. airborne division for the performance of fire missions, in addition to small arms, are the following: 54 105 mm howitzers, 127 106.7 mm and 81 mm mortars; 66 M551 Sheridan light tanks armed with a 152 mm howitzer firing artillery shells or the Shillelagh antitank missile; 17 fire support helicopters armed with an automatic cannon, as well as TOW antitank missiles or 70 mm rockets. Presently organic to the division are Dragon antitank missiles. 40 mm grenade launchers (a total of 1,536 in the division) are employed to destroy machinegun nests and small concentrations of enemy personnel on exposed terrain and entrenched. Foreign periodicals note the capability of rapid on-loading of all these weapons into aircraft, rapid readying for action after being dropped or landed in the objective area, as well as their high degree of battlefield mobility. For engaging hostile aircraft, the division is armed with 48 6-barrel Vulcan antiaircraft guns and 63 Redeye antiaircraft missile units. Low-flying enemy helicopters would also be destroyed by small arms fire, antitank missiles, and in some cases by conventional artillery.

The maneuver capabilities of the airborne division have been enhanced by the inclusion of the above-mentioned 66 Sheridan tanks, 88 helicopters, and more than 2,000 units of airlifted motor transport vehicles. Considerable importance is attached to the adoption of self-propelled 105 mm howitzers. The tanks and self-propelled howitzers increase the degree of protection of assault force equipment against nuclear weapons, while the helicopters and motor transport vehicles promote swift dispersion to minimize the effects of a nuclear strike. Future plans call for a further increase in the number of armored vehicles in the division. The magazine ***AVIATION WEEK AND SPACE TECHNOLOGY*** has mentioned the possibility of future assault force personnel employment of portable flying devices, "increasing the individual soldier's mobility and survivability on the battlefield."

Helicopters have proven to be a qualitatively new means of assault force delivery in comparison with fixed-wing aircraft. Helicopter utilization does not require expensive airborne assault hardware and extensive troop special training. In addition, much less time is required to ready an assault force, for it is no longer necessary to pack parachutes and parachute systems, and to ready personnel, combat equipment and supplies for the drop. The assault force is landed in the same tactical grouping in which the combat mission is to be carried out, that is the force lands with a high degree of combat readiness. All this makes airborne assault operations a more mass means of warfare.

Due to the differing capabilities of fixed-wing and rotary-wing aircraft, there has occurred, as it were, a distribution of zones of airborne assault employment. Military transport aircraft would deliver assault forces (from a brigade to several divisions in size) to a depth of from 100 kilometers to a global distance. Helicopters would deliver primarily battalion-size forces, and sometimes brigades, to a depth of up to 50 and 100 km respectively.

* * *

Part 2, Views on Utilization, *is omitted. It discusses the U.S. standard classification of airborne assault forces, general procedures followed in preparations, delivery of airborne assault forces behind enemy lines, and the nature of combat operations. It deals with parachute delivery of airborne forces.* **Part 3, Plans and Predictions,** *follows. It encompasses airmobile employment of airborne assault forces.*

* * *

Taking into consideration the development of the diversified components of vertical maneuver forces, Western military theorists are endeavoring to define the role and place of each in warfare applicable to present-day conditions as well as in the future. Practical experience abroad indicates that the solution to this problem has been far from easy. Bourgeois military experts have been engaged in stormy debate on the dominant role of a given component, and various suggestions are advanced pertaining to proportion in their development as well as delineation of tasks and missions among them.

Today nobody denies the fact that military transport aviation and airborne troops have ceased being

the principal forces in executing vertical maneuver in ground forces operations. But there still remain many advocates of the leading role of airborne assault forces. Basing their arguments on past experience as well as the increasing capabilities of military transport aircraft and global-range nuclear missile systems, some military theorists dream of the rebirth of airborne armies capable of conducting airborne operations of unprecedented scale.

As is well known, attempts to form and utilize such armies were undertaken in World War II. For example, in 1944 an Anglo-American airborne army was established, which contained three American and two British airborne divisions. However, practical employment of this army was limited to a single occasion — the dropping of a large airborne assault force in Holland in 1944.

This operation was conducted under conditions of absolute Allied air superiority and a vast superiority on the ground. Its effectiveness and expediency are variously assessed. The authors of a draft plan for new airborne armies, as is evident from a book by U.S. military theorist [D. M. Geyvin] entitled ***Airborne Warfare*** declare that "the effectiveness of the airborne army was proven by the entire course of the Dutch Operation. Many such armies will be needed." According to another view, this operation did not produce any significant operational-strategic results which would justify the enormous expenditures involved. The operation was counting more on producing a political than purely military effect.

Many military theorists in the West come to the conclusion that the attempt to revive the idea of airborne armies is a consequence of the "inertia of thinking" on the part of its advocates rather than a result of an objective need. One's attention is drawn to the fact that when only one airborne division is employed as an airborne assault force, it is necessary to employ extremely large numbers of military transport aircraft, fighters, fighter-bombers and bombers, as well as large quantities of other forces and facilities. Other utilization of all this personnel and hardware could exert greater influence on the course of a battle than the dropping of an airborne division. One's attention is also drawn to the fact that with modern air defense weapons, which are exceptionally effective against targets at the middle and high altitudes from which a division is usually dropped in an airborne operation at considerable depth, losses in the air may prove much greater than allowable.

The "Redeye" missile launcher

In view of the increased threat of heavy losses in personnel and equipment during delivery to the objective area, there have appeared doubts about the advisability and possibility of a massive delivery of airborne troops behind enemy lines under conditions of nuclear warfare. Advocates of this view claim that in a nuclear war the employment of airborne troops will boil down primarily to the delivery of small assault forces and raiding parties. According to the magazine ***MILITARY REVIEW***, the brigade is considered for the future as an optimal combined unit of airborne troops.

Another reason for modest estimates of the future of airborne troops was the appearance and extensive utilization of combined units of the airmobile type — organi-

The "Sheridan Shillelage" armored reconnaissance vehicle

cally adapted to transport by air. With establishment in the United States in 1963 of the first such combined unit,* further development of airborne forces, development of the theory and practice of employment of airborne assault forces is taking place within the framework of a sharp debate on where preference should be given: to airborne or airmobile troops.

Following extensive experiments the Pentagon converted the 11th and 101st Airborne divisions into airmobile divisions.** In the opinion of Western military experts, under the conditions of Indochina, airmobile divisions possessed a number of advantages over other ground forces combined units. The magazine ***ARMY*** also expressed "doubt as to the expediency of maintaining airborne troops in the present day."

In contrast to airborne troops, airmobile troops execute repeated moves by air, utilizing organic equipment, and operate in a single unified attacking or defending force, and consequently are provided cover within the overall friendly air defense system. They penetrate hostile air defense not only with the aid of weapons and facilities under the higher echelon but also employing their own organic equipment en route, particularly helicopter-carried weapons. Advocates of airmobile combined units also focus attention on the fact that such units, in contrast to airborne troops, are equally essential and can be successfully employed both in offensive and defensive engagements.

At the same time there is an increasing number of military experts abroad who feel that each of the components of vertical maneuver forces possesses advantages and drawbacks, and consequently [each possesses] a specific place within the structure of modern armed forces and within the system of armed combat, as well as a quite definite future. They list as the principal and very important advantages of airborne troops their greater strategic mobility and their adaptation to rapid delivery by air hundreds and thousands of kilometers.

The existence of global weapons systems dictates the scope of combat on a worldwide scale and the necessity of possessing ground forces which are specially adapted for swift maneuver by air over practically necessary distance. Proceeding from this, U.S. military leaders, according to the magazine ***ARMY*** believe that "until other means of delivering conventional troops to remote areas are found, it will be necessary to maintain airborne units in the strategic reserve."

At the same time, within the framework of ground forces operations, NATO military theorists are showing increasing preference for airmobile troops and army aviation, as well as the adoption of new forms and methods of combat based on the above.

We must note that flight of fantasy in elaborating plans frequently runs far ahead of the realistic capabilities of the facilities and resources available in the NATO countries. For example, some Western military theorists propose organizing airmobile corps adapted both for delivery on a strategic scale by military transport aircraft and for the conduct of airmobile operations in a designated combat area with utilization of organic helicopters and other aircraft. Others propose the idea of establishing corps which, operating in the operational-tactical zone, would constitute a "supermobile" force moving on the ground and in the air, "capable of delivering swift and deep attacks." The combat operations of such a force, states the magazine ***MILITARY REVIEW***, would assume unusual forms, based on "swift detection and determination of targets, fast closing with the enemy, maneuver and devastating application of pressure."

However, as this same magazine emphasizes, existing facilities and resources do not provide the possibility of conducting such operations.

In spite of this fact, a number of bourgeois military theorists continue to consider modern airmobile combined units and units as a prototype of airmobile armies of the future. In their opinion such armies would be capable of delivering swifter and deeper attacks than have been possible in the past. They will constitute, states the magazine ***ARMOR***, a prerequisite for development of the concept of "blitzkrieg warfare" on a new and higher level.

Such are the plans and predictions. In actual practice, as was demonstrated in the two preceding articles, NATO military leaders assign airborne assault forces an important place within the system of warfare for execution of their aggressive schemes. Airborne troops delivered to the objective area by military transport aircraft are viewed by them primarily as a strategic means. On the operational-tactical scale increasing attention is being focused on airmobile troops and army aviation.

Counting on the potential of increasing air transportability and the utilization of various vertical maneuver forces, Western military theorists are developing the idea of a new variant of "blitzkrieg warfare."

*This refers to the 11th Air Assault Division (Test) organized 15 February 1963 to test concepts recommended by the Army Tactical Mobility Requirements Board (Howze Board) which was convened in 1962.

**On 1 July 1965 the 1st Cavalry Division (Airmobile) was activated largely from elements of the disbanded 11th Air Assault Division. The 1st Cavalry ceased to be an airmobile division on 20 February 1975, the day the 6th Cavalry Brigade (Air Combat) was activated. On 4 October 1974 the 101st officially became the 101st Airborne Division (Air Assault).

VIEWS FROM READERS

Sir:

After... experiencing a bird strike in which all three UH-1 crewmembers were caught after dark with tinted visors up by the entry of a high flying Night Hawk into the cockpit, I find myself wondering what progress, if any, has been made toward development of an effective day/night visor system for the SPH-4 helmet. The present approach of changing lenses from clear to tinted and back again is a big project on the ground and virtually impossible in the air where the need for either visor may occur suddenly due to changes in available light. The most apparent remedy is to use the clear visor at all times, wearing sunglasses during the day. However, this solution does away with the fine tinted lense and increases pilot fatigue from the pressure of ear pieces under the ear cups and higher noise levels due to the less effective seal. This approach also tends to encourage the use of sunglasses alone with no visor protection.

We are all aware of the problem and also can see the logic behind the stock answer that dual visor systems employed by other services will upset the critical balance of the helmet. Now that we've entered the era of mid-intensity warfare with its heavy emphasis on NOE, night flying and the increasing potency of ground to air weaponry, effective protection of crewmember eyesight seems even more important. How about a progress report on just where we stand in the development and adoption of a really safe, simple and effective visor system?

CPT Robert D. Mabey
396th Aviation Company (Army)
Utah Army National Guard
Bountiful, UT 84010

• **The *DIGEST* received the following response to CPT Mabey's letter from the U.S. Army Aeromedical Research Laboratory (USAARL):**

A field survey of aviators conducted during May 1975, revealed that 30 percent of the 900 that answered the survey made unsolicited comments regarding their desire for a dual visor system.

USAARL is working with a prototype dual visor system mounted on an SPH-4 helmet. (see photograph). There are problems of adding a dual visor system to the SPH-4 helmet as you mentioned in your letter. It adds additional weight, and helmet center of mass is affected. The adoption of a dual visor system is to be one of many topics of discussion during an In-Process Review (IPR) which has been requested by the Surgeon General since January 1975, but as of yet has not been called.

A recommendation, based on personal experience, to alleviate both the comfort problem and the loss of noise attenuation when wearing issue sunglasses with the SPH-4 helmet, is the replacement of the plastic covered temple with the below described temple:

NSN: 6540-00-926-9013
Noun Nomenclature: Temple, Spectacle
Description: Gold filled comfort cable type, 6½ inches.

This item is available through the supply system and requires only minutes to accomplish the change. Regular changes of the earphone seals, which harden, also will aid in alleviating the above mentioned problems. Pertinent requisitioning data for the earphone seals is: seal, earphone, NSN 8415-00-143-8577.

Prototype Dual Visor SPH-4 Helmet developed by USAARL and Gentex Corporation

Sir:

The following is an announcement of our Special Summer Program which we believe may be of interest to readers of ***U.S. ARMY AVIATION DIGEST:***

Air Transportation Systems Analysis
Massachusetts Institute of Technology
12-13 July 1976

The program is concerned with air transportation in its broadest sense. The technological, operational and economical aspects of problems in air transportation are addressed concurrently. The program is pointed toward aiding the air transportation system by identifying the effects of new technologies, studying current and future problems, and describing new methodologies for analysis of operational and economic problems.

For further information, please contact:
Director of the Summer Session
Room E19-356, M.I.T.
Cambridge, MA 02139

Robert W. Simpson
Director

The U. S. Army in Vietnam
A Pictorial Record

The Center of Military History is preparing a pictorial volume in the Army's official history of the Vietnam War and would welcome photographs illustrating the following subjects: Viet Cong and North Vietnamese Army activities, morale and discipline in U.S. Army Republic of Vietnam, Vietnamese life in the cities and on the outskirts of U. S. bases, battle damage and combat. All contributions—prints only, no slides—should be sent to:

Dr. Joel Meyerson
U.S. Army Center of Military History
Forrestal Building
Washington, DC 20314
(202) 693-5375; (Autovon) 223-5375

THE CASE OF M

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Education
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MOST OF US have been embarrassed by speaking to someone we thought was an old friend. This person may have looked like that friend at first glance, but a closer look revealed otherwise. It's a case of mistaken identity. How could a person make such a mistake? Did the person's hair look the same or was the walk similar?

People tend to identify persons and objects using these and many other visual cues which are learned by association. As an Army aviator you must be able to identify enemy equipment or terrain features, especially at night during terrain flight.

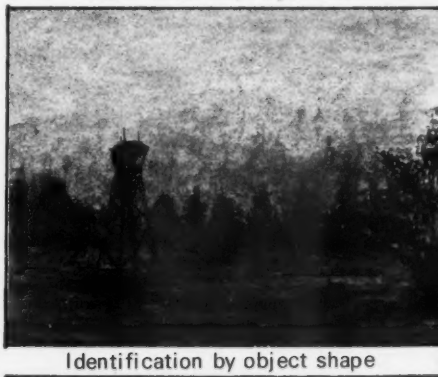
During daylight hours the enemy uses camouflage to minimize detection from the air. To detect camouflaged targets, aircrews must use proper observation techniques. During night operations the aircrews' ability to identify objects is more difficult.

To overcome limitations of darkness, aircrews must understand factors affecting terrain interpretation at night and learn visual cues that aid in identification. The likelihood of detecting a natural or manmade feature at night depends primarily on the following factors:

- *Object size:* It is extremely difficult to perceive small objects at night. Large structures and terrain features (such as churches, water towers and rivers) are more easily recognized in darkness than are small objects (such as a tank or truck) which becomes lost in the environment. Identifying the smaller object requires a longer viewing time and a shorter viewing distance.
- *Object shape:* That tank, however, which could not be recognized because of its relatively small size in relation to the environment, is easily recognized when viewed from the side because of its distinctive silhouette. A natural or manmade object is identified at night by its shape or the silhouette it forms. Familiarization with the architectural design of buildings assists in recognition of structures at night. Also, shape assists in identifying objects that are difficult to recognize because of their small size. Shape of terrain features also provides a means of identification at night. Open fields which are shown on the map as triangular shaped provide positive identification when viewed from the helicopter. Landmarks such as a bend in the river or a prominent hilltop provide a distinct shape which aids in terrain interpretation at night.
- *Viewing distance:* Because the viewing angle becomes smaller as the distance from the object increases, large objects which are distinctive in shape may not be recognizable from a great distance at night. This, combined with poor depth perception at night, leads to faulty judgment of size. Also, objects lose form as the viewing distance increases. A church building viewed at close distance at night appears as a large structure with a distinctive high roof; however, viewed at a great distance it resembles a family dwelling. This phenomenon occurs when viewing military targets or terrain features at a great distance. The distance at which interpretation of an object becomes unreliable is also dependent upon the ambient light level. An object that is identified by its shape and size at a distance of up to 1,500 meters, during a high light condition, might be unrecognizable at 500 meters during low light condition.
- *Contrast:* Identification of terrain features by contrast is dependent upon the available ambient light, the color and texture of the object being viewed and its background.

The ambient light level affects the degree of contrast that exists between objects. The higher the light level, the greater the contrast. This is because the reflectance is a constant percentage of illuminance. Therefore, as the illuminance level increases, contrast or absolute difference between objects increases. Each object possesses a different reflectance due to the nature of its reflective surface. As the ambient light increases, more light is reflected causing a shade change. Objects with a poor reflective surface appear black during low light levels and dark gray during high light levels. Objects or

Identification by object size



Identification by object shape

MISTAKEN IDENTITY

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terrain features possessing good reflective quality appear a much lighter gray under all conditions of ambient light.

The color and texture of an object or terrain feature affects its reflective quality. This characteristic of an object or terrain feature aids or detracts in identification by contrast. An open field which is light in color with no vegetation growth is an example of an optimum reflective surface. Areas covered with dense vegetation provide the worst conditions of reflectivity. Seldom is terrain encountered where the extreme of both cases exists. Knowledge of the reflective quality of objects and terrain features aids in identification by contrast. Objects and terrain features most affected by contrast are:

Identification by object viewing distance

Identification by object contrast

✓ **Roads:** Dirt roads provide excellent contrast between the surrounding terrain and its surface. This is more pronounced where the road is cut through heavily forested areas. Normally a dirt road varies in soil texture and color from that of the soil adjacent to the road. This condition further improves the contrast of the dirt road and surrounding terrain. Asphalt roads are difficult to identify because the dark surface reflects very little light, reducing the contrast between the road and surrounding terrain. Concrete highways provide an excellent reflective surface and are easily identified at night.

✓ **Water:** Bodies of water provide very little contrast against a land mass during low light conditions. Viewed from the air, lakes or rivers appear dark gray. As the light level increases water begins to change color, contrast increases and reflected moonlight easily is detected. When a surface wind exists, the reflection off the water is intensified by the ripples, which further aids identification. Bodies of water are recognized more easily when viewed from an angle rather than directly overhead.

✓ **Open fields:** Contrast is very poor in cultivated fields. Most crops are a dark color and tend to absorb light. During the harvest or dormant time of the year, the color of vegetation becomes lighter and contrast improves. A recently plowed field may be void of vegetation; however, because of the coarse texture of the soil (caused by plowing) light is absorbed and very little is reflected.

✓ **Forested areas:** Heavily forested areas do not reflect light and appear as dark areas at night. Excellent contrast exists between an open field and a forested area that normally surrounds an open field. If flight is conducted over terrain which heavy vegetation dominates, difficulty is experienced identifying objects and terrain features because of the lack of contrast.

✓ **Desert:** The light color of the soil and sparse vegetation growth characteristic of desert terrain provides the best condition of detecting objects and prominent terrain features by contrast. Military targets easily are recognized on the desert due to the dark color of barren mountains as contrasted against the light color of the flat terrain.

To ensure the success of a night combat mission, aircrewmen must be aware of the factors which affect terrain interpretation at night and apply these principles during the conduct of their missions. A mistaken identity of a friend results only in embarrassment–but a mistaken identity of enemy weaponry or a terrain feature may result in disorientation or the defeat of a friendly land force.

We have discussed basic considerations that aircrewmen must be familiar with in order to identify objects and terrain features at night. Further consideration must be given to the environment, e.g., terrain, seasons, visibility restrictions, etc., prevailing at the time the mission is being performed. This will be the subject of a future article pertaining to night terrain interpretation.

Readers of this article should be aware that a new publication, TC 1-28, "Rotary Wing Night Flight," soon will be available for units in the field. It establishes the basic principles of night rotary wing flight and should be referred to for unit and individual night flight training.

Remote Set

Continued from page 7

testing of both fuzes was conducted in a simulated battlefield environment, against various targets, with highly satisfactory performance. The engineering portion of DTII also was completed with satisfactory results.

The RC fuzing subsystem consists of the XM-433E1 and XM-439 fuzes and the XM-40 remote fuze setter mounted on the AH-1G helicopter.

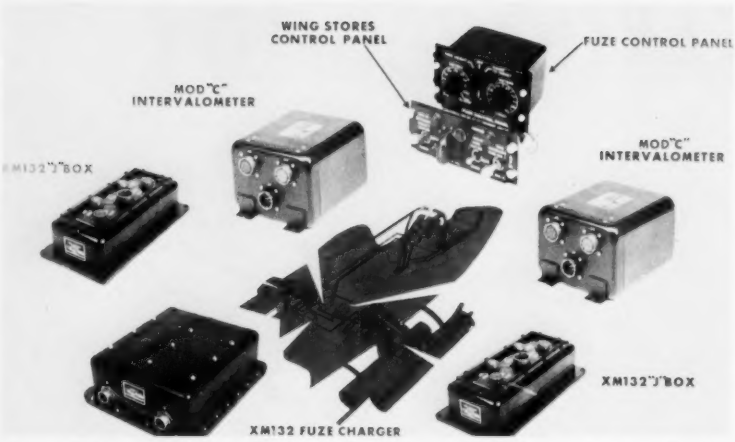
The XM-433E1 fuze, attached to the front of the warhead, consists of the following modules: electronics, safe and arming (S&A) mechanism, steel housing, booster assembly, foliage sensor and umbilical assembly. The umbilical assembly is protected by a shipping cover.

The XM-433E1 fuze has two post-impact electronic delay options and one super-quick option. It provides the attack helicopter pilot with the capability to destroy targets protected by dense forests (up to 45 meters tall), protected by bunkers (up to 3 meters thick), hidden in buildings or exposed and in open terrain. Even light armor targets are vulnerable to warheads with this fuze.

The XM-439 fuze consists of a similar electronics module, S&A mechanism, and plastic housing; however, unlike the XM-433 fuze, it is mounted in the base of the XM-255 flechette warhead. This fuze can be adapted easily to any warhead that requires airburst function with variable time.

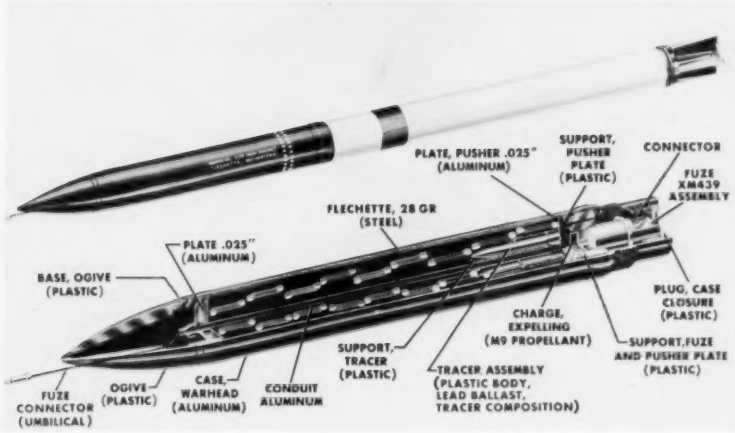
The XM-439 fuze has time delays settable manually in 250-meter increments from 500 to 4,000 meters using the fuze control panel. When fire control is available on the aircraft, fuze setting can be automatic and the fuze will then be set with the exact range to target.

The XM-40 remote fuze setter subsystem consists of the fuze control panel, a dual fuze setter and two "J" boxes to synchronize fuze setting and rocket firing. This sub-



Remote fuze setter subsystem (XM-40) integrated into the Army/Bell AH-1G attack helicopter and interfaced with mod C rocket firing subsystem. The fuze control panel is located next to the wing stores management panel on the pilot's console. The pilot selects the required fuze functioning mode and delay using the left side switch for XM-433E1 or the right side switch for the XM-439. Two fuzes of the same type are set simultaneously by the fuze setter at the time of rocket firing. The pilot has only to set the mode or delay, and press the pickle button. "J" boxes provide synchronization for fuze setting and rocket firing

Multioption impact time delay fuze XM-433E1 with M-151 and M-229 high explosive warheads. Umbilical protruding from the fuze provides a communication link between pilot and the fuze via XM-227 launcher. Fuze cover, providing protection of canopy switch and umbilical during handling, must be removed prior to loading the round into the launcher. Timing begins when the sensitive canopy switch impacts an object of medium density. The steel fuze body protects the electronic module and S&A mechanism during hard target penetration



XM-439 variable time delay fuze with XM-255 flechette warhead. The umbilical, protruding from the nose of the round, provides the communication link from the pilot, through the launcher to the fuze. The base mounted fuze starts timing on first motion of the round

system is complimented by the rocket firing Mod C intervalometer subsystem and XM-227—19 tube launchers.

The fuze setter is a relatively simple device that provides the fuze capacitors with compensated charges that provide the desired functioning time. The fuze setter consists of time to airburst (or range) selector (fuze set panel), a precision (direct current) voltage source with control circuits, a voltage monitor (operational amplifier), a precision events sequencer and analog computer. At the time of fuze setting, the time constant of the RC timer is compared to the reference in the fuze setter and the capacitors are charged with compensated voltages to provide the desired time function.

The fuze charging is conducted in the following manner: With the fuze connected to the fuze setter and the range selected, either automatically by the fire control or manually by the pilot adjusting the range selector on the fuze control panel, the voltage levels on the fuze timing and power capacitors are established. The voltage on the timing capacitor varies as a function of the time delay desired and the voltage on the power capacitor stays at about the same level.

When a rocket is launched with the XM-439 fuze, or a rocket impacts a target with the XM-4331E1 fuze, the starting switch closes and current flows until the voltage on the timing capacitor reaches zero. This condition actuates the trigger circuit, which dumps the remaining charge of the power capacitor into a detonator, initiating the explosive train.

Technological approaches to improve accuracy, versatility and tactical effectiveness are constantly being evaluated. For instance the automatic setting of the XM-439 fuzes has been proven using a coupled LASER rangefinder, thus eliminating the need for the pilot to set the fuze manually. Automatic fuze setting will be possible when fire control completes development.

The RC remote set fuzing subsystem for helicopters is the only developed and proven system in existence today. Further application of the remote set fuzing for aerial rocketry as well as ground weapons will greatly improve tactical effectiveness and versatility of free flight rockets.

Fuze set panel on pilot's console of the AH-1G attack helicopter. Pilot using controls on this panel sets the remotely controlled fuzes to desired functioning distance or mode, prior to firing the rockets

THE FAA MILITARY COMPETENCY EXAMINATION

Edward A. Ewell
Aviation Learning Center
U. S. Army Aviation Center

THE MILITARY Competency Examination, prepared and offered by the Federal Aviation Administration (FAA), is one of the most important and most significant civilian transitional vehicles offered the military aviator. This examination provides the graduate Army aviator with the opportunity to apply the skills and knowledge acquired through Army aviation for the acquisition of the civilian commercial pilot's certificate. The graduate Army aviator who successfully completes this examination is awarded the Commercial Pilot Rotor Craft certificate with the "instrument" rating. The comparable civilian value to acquire this certificate, based on today's prices for flying time, could exceed $30,000.

The FAA Military Competency exam has been offered at Fort Rucker since 1965. During 1968 and 1969 when student training was at an alltime high, an average of 100 to 125 students per week were tested and awarded this valuable license. Mr. E. M. Marshman,

FAA representative at Fort Rucker, offers this examination every 2 weeks at the Aviation Learning Center. Mr. Marshman is assigned to the Air Traffic Division of the FAA and has been given special permission by the FAA to administer this examination. Normally only an examiner assigned to the General Aviation Division has this authority.

For those who are apprehensive about taking this exam, let me say it may not be as comprehensive as you may think. The FAA holds that your achievements as a graduate Army aviator and your flight orders are prima facie evidence of flight competency. This exam covers Federal Aviation Regulations (FARs), Parts 1, 61, 71, 91 and the National Transportation Safety Board Regulation, Part 430. You may have learned of these FARs as an integral part of your aviation training; however, there are no resident training classes in the flight programs specifically designed for teaching the FARs. This means it is a good idea to review the above regulations prior to taking the exam.

The Aviation Learning Center has prepared a sound and slide lesson that covers important areas of the FARs. It provides a comprehensive review of these regulations to enhance your present knowledge of the subject. It also covers many recent changes in the regulations. This lesson is divided into three parts:

- Regulations concerning aircraft certification, pilot certification and currency requirements, etc.;
- Weather minimums and controlled and uncontrolled airspace, etc; and
- Terminal control areas, rules of right-of-way and airport tower signals, etc.

Programed texts on these regulations will be provided at your request.

Other commands having requirements for this Aviation Learning Center lesson can procure it through their local Training Aids Services Office (TASO). All of the resources of the Aviation Learning Center are placed at your disposal as you prepare yourself for the exam. The rest is up to you. All active duty military aviators on flying status who meet the currency requirements (10 hours in the last 12 months) are encouraged to take the test.

Additional flight qualifications acquired during your aviation career—such as fixed wing, multiengine, etc.—can be added to your Commercial Pilot Rotor Craft certificate at this time. Other than proof of currency in the aircraft, there are no further examinations or requirements necessary. If you are not current in some of the additional areas you want included on your certificate, you can bring the certificate to the General Aviation District Office when you become current and have these additional qualifications added. And again there are no additional requirements for further testing.

U.S. Army Reserve and National Guard aviators on active flying status who meet the currency requirements have the same privilege as the active duty military. The only additional burden on these aviators is that they must go to their nearest General Aviation District Office to take the exam, unless they are stationed near Fort Rucker.

Not only active duty, but ex-active duty personnel who meet the above currency requirements and take the examination within 12 months after discharge, also qualify to take the FAA Military Competency Examination. Based on comments made by FAA and civilian flying school representatives, many ex-military aviators have allowed 12 months to slip by without taking advantage of this opportunity.

If you are at Fort Rucker for any course, you may wish to consider the following steps if you would like to take this examination.

- Complete the instrument portion of the flight program.
- Come to the Aviation Learning Center and go through the three-part lesson that has been prepared on the Federal Aviation Regulations.
- Come in and take the examination.

The exam is given every other Wednesday (the dates are posted at the Aviation Learning Center). Mr. Marshman sends the exams to Birmingham, AL, for grading and the results are received in a few days. A week prior to graduation you will take the results of the examination to the FAA representative's office and complete your application for the certificate. On the day of the formal graduation from the aviation flight program, the General Aviation District Office representative will be at the Aviation Learning Center to sign your license. You will be required to bring him a copy of the orders making you an aviator and a copy of your flight records. You will then have the civilian equivalency of many thousands of dollars worth of certificate. The entire procedure is simple.

If for any reason you should fail the 40-question exam, you may want to retake it soon. You are eligible again anytime after 30 days, or anytime you can show evidence of receiving additional related instruction from an FAA ground or flight instructor.

The cooperation between the FAA and the U.S. Army Aviation Center is part of the overall federal effort to translate military training into needed civilian job qualifications.

Don't be left out! Make arrangements to take the FAA Military Competency Examination and receive your Commercial Rotor Craft certificate. This examination has been made available by the Federal Aviation Administration and is intended just for *you*.

Second in a series of four articles on

why pilots make errors

IN A PRECEDING article, we talked about psychology as it is viewed from two different approaches. One viewpoint was mentalistic in nature and focused on the study of the mind. Scientific psychology, however, focuses on the study of behavior. We looked at three things that affect behavior—the environment, physical states and previous behaviors. Let's take a closer look at behavior.

Science is not a fly-by-night operation. Science does not take one look at a phenomenon, but rather it takes several looks. Science looks for observable, measurable things. Science also requires that these observable, measurable things be the same each time they are looked at. We may be able to see an event and even measure it, but if we can't show a rerun of the event, we're in trouble. Big trouble. I once had a small black dog that flew down the hall of my house. It flapped its ears and must have flown about 25 feet. The little critter only did it once—now nobody believes me. Why? Because I can't get the little feller to do it again and show 'em.

William C. McDaniel
Directorate for Technical Research and Applications
U. S. Army Agency for Aviation Safety

Repeat, replicate, verify, do it again are key words and phrases to scientific study. So we need to add another qualifier to behavior. It must be observable, measurable and *repetitive* behavior. A very large portion of repetitive behavior can be referred to as *learned* behavior.

Learning

The study of learning is a cornerstone to the foundation of the analysis of behavior. We learn to walk, swim, drive, talk, and, yes, even fly. Each of us learns unique behaviors, such as excessive talking at parties, gestures, facial expressions, etc. Some folks learn "undesirable" behaviors. Thieves have learned to steal, drunks have learned to drink, drivers learn to speed, pilots learn unsafe procedures in aircraft, etc. All of these behaviors combine to form the very popular psychological term "personality." Using this approach, it should be obvious at this point that such descriptors as "weak personality," "dependent personality," "personality disorder," etc., tell us very little. The descriptors are too gross; what we're really interested in are the specific behaviors that led to such a gross label. In fact, there is an increasing tendency in psychology to avoid such labels.

Now that we've looked at the scope of learning, how do people learn? They learn by a simple procedure. They move (behavior). If something happens they like, the movement (behavior) will be repeated. Before you get excited and throw this article in the trash because you already knew this, you've been doing this for years, and it doesn't take any fancy school-trained psychologist to tell you something you already know, hold it! You're right—it is simple. It is just plain commonsense. You have probably already been using this procedure. Using it most effectively is a horse of a different color.

We have too many "personality problems" that could be solved if only the proper procedure were applied. Checklists are not followed, tools are left in aircraft, inspections are not completed, and on and on and on. These are all results of human behavior. If it occurs more than once, chances are it is learned behavior. One further point—scientific psychology removes a crutch people have used for years. Joe Turkey leaves tools in the aircraft because he's "absentminded." We can't do anything; Joe Turkey's mind is in control. Hogwash! Simply put, the proper learning procedure was not applied so that Joe Turkey would behave in the desired manner, i.e., remove tools from aircraft. If Joe Turkey had learned that removing tools, etc., would get him things he wanted, i.e., promotion, respect from peers and superiors, and that not removing tools would get court-martials, Article 15's, busts, etc., he would more likely have removed the tools.

Positive Reinforcement

Let's look at the procedure again and see how Joe might have developed his undesirable behavior. Joe fixes an engine and leaves a pair of pliers on the aircraft (behavior). He walks into the shop on completion of his work. The shop chief, having a job completed and not knowing Joe left the tools, comments, "Good job, Joe." (This praise is something Joe likes. Psychologists call this positive reinforcement.) Joe has been praised for not only doing a good job but also for leaving tools in the aircraft. The shop chief has just increased the chances that Joe will leave tools in an aircraft again by *reinforcing* this response.

Joe again leaves tools in the aircraft (behavior) and the shop chief calls his attention to it in a joking manner—"Joe, I bet you left the aircraft full of tools again." Joe gets attention, something he likes (positive reinforcement) that further strengthens the behavior. Things go from bad to worse. The shop chief "chews out" Joe by telling him he is a sloppy soldier. Joe doesn't know that the chief is only chewing him out for leaving tools in the aircraft. He thinks he is getting criticized for his work overall. He then may lose interest and begin to do poor work also (or something to this effect).

One point should be made clear about this situation. Our logic tells us that certainly no shop chief in his right mind would reinforce leaving tools in aircraft. Our logic further implies that Joe Turkey would really have to be a dodo to not "filter out" the praise of doing a good job from a stupid act of leaving tools in the aircraft. Unfortunately, we assume too much with our logic. Research results indicate this just ain't so. If a behavior occurs and is reinforced, *all* behavior will tend to be repeated.

An excellent example can be seen on the Saturday afternoon baseball game. Pro baseball players like base hits and home runs. As each player addresses homeplate, he goes through a little individual ritual. He'll tap the plate three times with the bat; sling the bat from his right hand to his left hand; adjust his helmet; pat himself on top of the head. All of these behaviors have little to do with hitting the ball. But each of these little behaviors has been reinforced by a base hit or a home run. How much do the ritualistic actions of the baseball player differ from Joe Turkey's action of leaving tools in the aircraft? The important point is that we cannot expect the other person's "mind" to rationalize his behavior.

Negative Reinforcement

There is another procedure for learning very similar to the one just discussed. If a person is in an environment he doesn't like (aversive to him) and he makes a movement (behavior) and the aversive environment is removed, that movement will occur again. Warrant Officer Eagle hurries through preflights doing a poor inspection. What may have caused this behavior to occur? Eagle was assigned a VIP flight to move General Hot Pants from point A to point B. Eagle didn't get the mission until Hot Pants was ready to board the aircraft. Hot Pants was irritated and in a hurry, voicing his irritations to WO Eagle. Irritated generals provide aversive environments for warrant officers. To expedite his departure, Eagle omitted much of the preflight check (behavior). He kicked the skids and lit the fire. As soon as the aircraft lifted off, the general's irritated behavior subsided, removing the aversive environment (negative reinforcement). The chances of omitting the preflight check (behavior) have just been increased when Eagle finds himself in another aversive or hurried situation.

Punishment

Up until now, we have looked at procedures to increase or reinforce behaviors. When a person behaves and receives something he likes, he will probably repeat the behavior in a similar situation. When a person behaves and something he doesn't like is taken away, he will probably repeat the behavior in a similar situation. If a person makes a movement (behavior) and receives something he doesn't like (punishment), the behavior will be less likely to occur again. Probably because of moral, ethical, legal and social implications, the effects of punishment have not been widely publicized or popularized. Nevertheless, punishment is an effective procedure to suppress a behavior. However, there are severe pratfalls when punishment is used.

Punishment tends to suppress all behavior at the time it is presented and not just the undesired behavior. We've got another problem, too. When we start something, sometime we will have to stop. If we present something to a person that he doesn't like, eventually we will have to withdraw it. Now we have a situation just as was described in *Negative Reinforcement*. Whatever behavior the person is engaging in at the end of the punishment is more likely to occur again. Spank your child until he cries and you have increased your chances of having a child that cries more often. Is spanking "bad" then? Not really—it just depends on the behavior you desire. You may wish to stop an aviator from flying under bridges. Punishment, in the form of grounding, delivered at the right time, will stop this behavior. Certainly you run the risk of the guy flying too conservatively, but ultimately you must decide which you prefer—an aviator who flies under bridges or one who is excessively conservative.

Don't feel as if you were stuck between a rock and a hard spot on these two options. As we will discuss later, the efficient use of these procedures will allow you to have your cake and eat it, too.

What about punishment in our aviation and work environments? We may use punishment more than we realize. Sergeant Hardnose is a maintenance chief. In his 15-man section, he has three "go-getters." The work standards of these three people are extremely high. They can be trusted to do a job in a most professional manner. In periods of high workloads, who does Sergeant Hardnose continually assign the more difficult and demanding tasks to? You bet. Work is not necessarily its own reward. In fact, these three "go-getters" don't like to work. They do a good job simply because it is an efficient way to reduce their workload. They like the extra time for personal business they get by doing a job fast and well. In actuality, Sergeant Hardnose is punishing his three best workers. The quality of their work (behavior) begins to be reduced. The workers' behavior reflects their feelings—"Why work hard, we'll just get more work."

To Sum Up

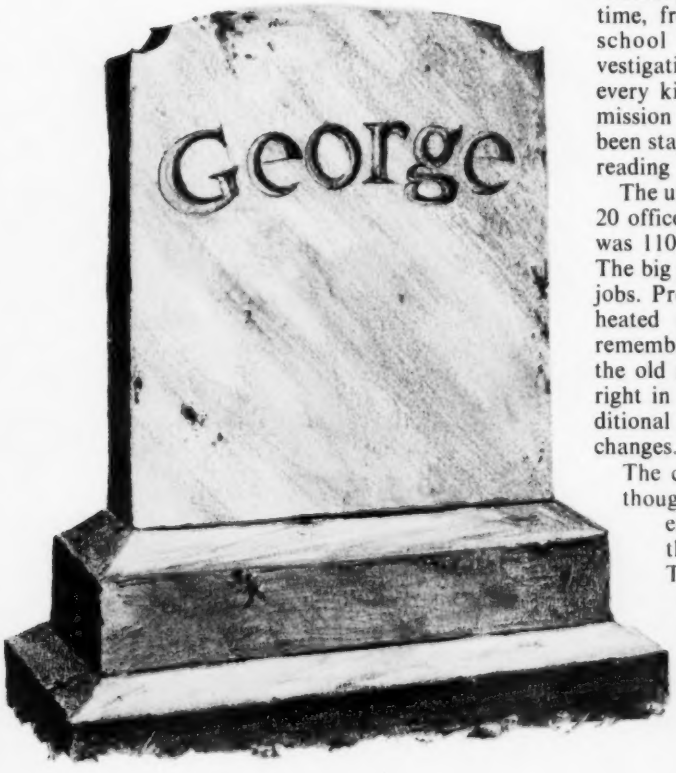
We have looked at three ways behavior can be learned. These ways or procedures are positive reinforcement (presenting something a person likes), negative reinforcement (removing something a person does not like) and punishment (presenting something a person does not like). As shown by examples, these procedures can have a profound effect on behavior. In the next article, we will talk about how these procedures can be used to help you in your life and on your job.

USAAAVS

David G. Holmes
Directorate for Plans, Operations & Education
U. S. Army Agency for Aviation Safety

Who Killed George?

Second in a series of episodes on George, your unit ASO who died from frustration after his training had taught him a better way



IT WAS THE Easter season. George sat in the chapel waiting for the service to begin. Others were still coming in, quietly filling the few remaining seats. His mind wandered.

Income tax, with its associated duress, had come and gone again. Spring holidays were almost here. The Mrs. wanted to catch the last of the snow in the mountains for some skiing, but George had spring fever and was pulling for the beach and the first of the new year's bikinis. The truth of the matter was that the IRS had effectively decapitated the family budget and they weren't going anywhere.

But things were pretty well settled at home—1-year lease signed, unpacking completed and curtains hung. Getting it together at work was something else. It seemed people just didn't have time for a young, low-time, fresh-from-safety-school captain ASO. Safety school had explored every phase of the investigation/prevention business with an example of every kind of mishap. No matter what your job or mission was, ways it could be fouled up had already been staged and recorded in one of the most expensive reading files in the world.

The unit was having growing pains. Last year it was 20 officers, 160 enlisted men and 10 aircraft. Now it was 110 officers, 1,050 enlisted men and 72 aircraft. The big problem was getting everyone trained in their jobs. Proper training had been the topic of the most heated maintenance/safety meeting George could remember. Just because a mechanic was qualified on the old model helicopters didn't mean he could step right in on the new birds without schooling and additional training. There were just too many small changes. The need for closer supervision was obvious.

The commander approached the pulpit. George's thoughts returned to the business at hand. The eulogy began. Captain Rodrigues—or Rod as they called him—was one of five fatalities. The helicopter came apart in the air—slung a rotor blade. A mechanic had reused a crushable washer on a torqued nut. The accident prevention program had broken down. The chapel bells tolled, the volley was fired—and George, too, died a little that day.

HEROES OR VILLIANS?

IT WAS A COLD, depressing winter morning. The time was 0500 hours, the ceiling was ragged if not overcast, humidity was extremely high and visibility was restricted. The sun, if it was going to show, made no sign. It seemed right for snow or freezing rain.

I trudged wearily to the airport and reviewed the requirements for the flight. I felt anyone in his right mind, after sticking his head out the window, would roll over and go back to sleep. However, I had a priority mission—fly six passengers and "special equipment" as soon as possible from Pisa to Verona, Italy.

I had a good crew. The copilot was well qualified in the U-1A and the crewchief had been assigned to this aircraft for the past 6 months. The aviation company had been flying a lot and maintenance was falling behind. As one pilot said, "It seemed a shame to ground a flyable aircraft just to work on it." The condition of this U-1A worried me, but nothing I could put my finger on. Because I was tired, I guess I felt the aircraft was tired, too.

The crew was waiting for me at the operations office. The crewchief had untied the aircraft and lashed down the cargo. The copilot, Bill, contacted the Air Force forecaster in Rome to get the latest weather. We could get through if we left immediately. Snow and freezing rain might be encountered over the mountains if we delayed our takeoff time.

I had been flying the two previous days so I told Bill he could be the pilot and I would act as copilot. I kidded him about the easy job he had been having as copilot, and that I would for a change relax on this leg of the flight. Bill agreed.

To expedite our takeoff he was to preflight the aircraft and brief the passengers on emergency procedures while I filed the flight plan. He left on the double to get the U-1A ready. I planned the IFR (instrument flight rules) flight plan, direct to Florence airport to join the airways, then on north to Verona. When I filed the flight plan I requested a heading due east to Florence to make our initial climb over the valley floor. Normally the center directed a north climb due north after takeoff, putting you immediately over the mountains. With a U-1A at maximum gross this left little margin for error.

After filing the flight plan I hurried out to the aircraft. A fast check with the crewchief and passengers and we were ready to go. As Bill taxied out I started through the takeoff checklist so we had most of it completed before reaching the active runway. Just as Bill checked the magnetos the tower called with our clearance. It had been changed to climb out north of the airport, etc. I called the tower and requested a change back to the original flight plan with the east departure. Tower said he would check with center.

Each minute on the ground decreased our chances

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USAAAVS

of getting through the mountains. It didn't make our waiting any easier. Finally the tower operator called and gave us our original clearance. We lined up on the active and made a last-minute check, including magnetos.

The right magneto had a 135 drop and the left had a 75 drop. We hastily attributed this to the engine loading up while we were waiting for our clearance. Bill decided it would burn off on takeoff. After all, we had been flying this same aircraft for the past several days. He applied power and we were airborne. The air was smooth and moist as we climbed to the east. I called Rome control when we were over Florence at 7,500 feet, IFR and still climbing, and we turned north on the flight course. A weather check with Florence indicated the ceiling was rising. The local airport was VFR. However, at our level we were still in the clouds with no hope of seeing the sun.

North of Florence, on course, we reached our altitude, still IFR at 9,500 feet. We were now over the mountains. I turned the navigational aids to Milan. Bill was on course, so we settled down for a routine flight.

The crewchief had just poured the coffee when *it* happened. I don't think any of us will ever forget the deafening silence, the complete silence. The engine quit. No warning; no nothing. Nobody spoke, as if with no conversation the engine would start again. Next there was a fast game of four hands around the cockpit as Bill and I attempted to restart the engine. Nothing!

Bill tightened his harness and asked, "What do you want to do?" A good question. There we were, IFR in the mountains with a dead engine. I was busy. First I told Bill to make sure he had aircraft control and then start a 180-degree turn to head back towards the valley. I returned the ADF to the homer located on the airfield at Florence and Bill turned back south, still on instruments. I told the crewchief to get chutes on all the passengers and to make sure they were properly adjusted. No one would bail out except on my order. The last thing I wanted was nine people spread throughout the mountains of Italy.

Trying to restart we found the engine would run, but only at idle rpm. Any increase in power made it cough, run rough and backfire, shaking the whole aircraft. We nursed as much rpm out of the engine as we could without its backfiring.

We had lost 500 feet when I called Milan control to tell them we had lost an engine and were returning to Florence. I requested they clear all traffic from the immediate area as we were still IFR and said I would call them before bailing out. Milan control came back, rather irritated that I had requested a change in flight plan, and asked "why I thought it necessary to clear all traffic in my area." I told them we had lost ALL engines, were still IFR in the mountains, and were attempting to make the valley. The controller in Milan then started talking in very rapid Italian, which I could not understand, so I turned the volume down.

We were now down to 8,000 feet, still IFR. The pilot and copilot windshields were covered with oil, blurring forward vision. Bill and I had flown this same route many times in the past. As long as he stayed on course to the nondirectional beacon at Florence we would be in a north-south valley with 6,000-foot mountains on either side of the flight path. Radio contact was made with the Florence airport, who reported 4,500-foot ceiling with 5-mile visibility. I told them of our problems and requested a crash truck to stand by in the event we made the valley floor.

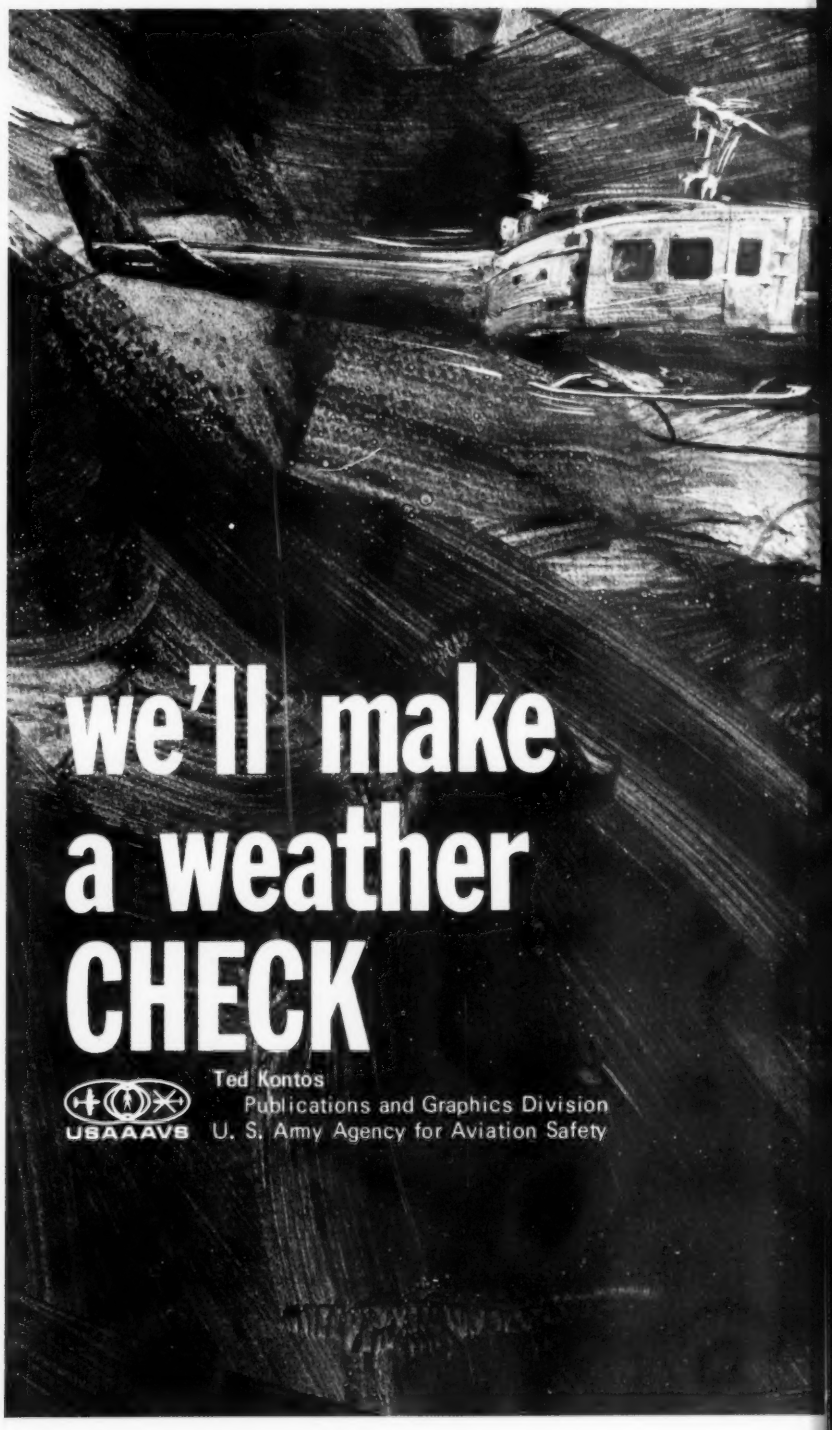
At 6,500 feet we were in and out of wisps of clouds. I explained to all the passengers that if they bailed out now I couldn't guarantee where they would land in the mountains. If they stayed with the aircraft our chances of reaching the valley floor were good, making an easier nylon letdown. Human nature being what it is, they elected to stay.

At 5,500 feet we broke out into the clear valley, with the mountains on either side of our flight route. Bill and I recognized local terrain features right away and for the first time the idea we might get down in one piece started to grow.

Bill could not see through his windshield, as it was covered with oil. I was able to lean forward and clean the oil off my side. This at least allowed some limited forward visibility. I gave Bill a GCA, or rather a "copilot's controlled approach," to the Florence airport. We had 500 feet on base leg and, with a short final, bounced to a stop. Bill could have logged three landings, but no one complained. We were down safely.

What had caused our problems and made this flight sheer panic? Our maintenance personnel found a small crack in an oil line connecting the top cylinders. This had allowed oil to flow back on top of the engine and drown out the magnetos. If Bill and I had taken time to verify the magneto drop at Pisa, we might have found excessive oil around the top cylinders. However, it was dark and we were in a hurry, so the preflight was hurriedly completed.

When we returned to home field, Bill and I both received a pat on the back for saving the aircraft. As I look back, maybe the pat should have been delivered a little lower and with more force.



While nourishment is necessary to maintain health, overeating may eventually result in a host of physical ailments; and although prescribed doses of medication can effect a cure, large or more frequent ones may kill. Excesses of even good things generally prove harmful. This is true of pride, self-confidence and motivation—especially motivation

PREPARATIONS FOR THE training exercise were completed, and takeoff for the troop insertion mission was scheduled for 0430 hours the following morning. A commissioned platoon leader was assigned the responsibility of acting as company and mission commander for the overall operation. Planning had been thorough and well coordinated between the supporting units and those to be supported. In brief, a flight of two UH-1s were to pick up and transport a total of 14 personnel to a point from which they could link up with friendly forces. Aircraft from another unit were to provide gunship support. Aircrews and pathfinders had been assigned, and the pickup and landing zones reconnoitered. Everything was in readiness. Only one possible problem was anticipated—weather.

Because of a thunderstorm earlier that day, considerable moisture existed, and early morning fog was forecast. Already light fog conditions were observed developing in the low-lying areas. Since the terrain was unfamiliar to the aircrews, and the flight was to be conducted during the early morning hours of darkness, the crews were in agreement that flight should not be attempted in fog. The mission could be cancelled, since trucks and necessary personnel were available and were ready to carry the troops to their destination if required. All that remained was the decision as to whether the personnel would be transported by air or by land. This decision rested with the platoon leader.

The following morning, before going to their respective aircraft, crews met in front of the flight operations tent to discuss the mission. While it was very foggy, the fog and haze were thin so that the moon and stars were visible. However, horizontal visibility was restricted to a degree that the tree line approximately 100 to 150 meters away was barely visible, with fog moving from west to east. The crew of the second ship determined that the weather was too bad for flying.

The platoon leader, however, made a phone call to an aviation company located near the pickup zone (PZ). He was told that the observed weather there was medium to heavy ground fog in the area of the PZ. Without advising the assembled crewmembers what he had been told, he decided to make an aerial weather check, selected the rest of his crew and launched toward the east.

Weather conditions to the west were known to be worse because of a river and lower lying areas.

Approximately 1 minute after takeoff, the pilot reported that the weather was bad to the east and that he was going to make a check to the west. The aircraft was seen crossing the landing zone (LZ) from east to west at approximately 100 to 150 feet agl in level flight at an estimated airspeed of about 60 to 90 knots. As

the aircraft approached the western sector of the LZ, the pilot reported worsening weather and decided to abort the mission. His aircraft was seen entering a normal turn to the left as it disappeared beyond the tree line. Radio contact was lost, and the aircraft was not seen in flight again.

The wreckage was discovered a few hours later. Based on a thorough study of available evidence, it was determined that:

After crossing the LZ and turning left, the aircraft descended so the pilots could maintain visual contact with the surrounding area. The aircraft was then flown into a small draw and visual contact with the ground was lost because of darkness, fog, haze and glare (it is suspected the searchlight was on).

At the entrance of the draw, the main rotor blades struck trees. The aircraft crashed and all aboard were killed.

The weather check attempted was poorly planned. A commercial telephone was available so an official weather forecast could have been requested or received from a trained forecaster.

No degree of urgency to go by air existed. An adequate alternative of inserting the troops by vehicles had been planned and coordinated.

AR 95-1 establishes night helicopter VFR flight takeoff minimums as a 500-foot ceiling, and 1 mile visibility (500-1). The visibility at the time the aircraft departed was considerably less than 1 mile. It is obvious that the pilot violated this regulation in the interest of mission accomplishment and because "weather check missions" are an accepted way of life in Army aviation.

Paragraph 4-3, chapter 4, AR 95-1, further establishes the requirements for all pilots to obtain a weather briefing before takeoff. Paragraph 5-4e, chapter 5, AR 95-5, requires that procedures be established for aviation operations originating from sites where weather operations and forecasting facilities are inadequate or nonexistent (where flights into marginal weather are apt to occur). Simply requesting weather conditions from a supported unit (which may have a parochial interest in having the mission flown) is not good enough. Trained weather forecasters and observers are available.

The pilot was apparently highly mission oriented. He had expressed a desire to fly as many night missions as possible. He had also recently flown a mission that had been refused by other crews because of weather.

Four words—excessive motivation to succeed—seem to best tell the story.

In contrast to the actions of the lost crew, the aviation unit commander who was to furnish the gunship support had issued orders for his personnel not to launch if they thought the weather was bad. The policy in the second unit limited weather checks to real emergencies, and definitely not in a training environment.

Even the infantry troops expected to be transported by trucks. All the companies had been told to use 2-1/2-ton trucks for the troop insertion mission if the airmobile lift was cancelled.

When the pieces are fitted in place, they seem to form a composite of an aviator who possessed desirable traits—traits the Army endeavors to instill in all individuals during training. Unfortunately, like a cancer cell gone wild, one trait—motivation—appears to have suddenly mushroomed out of proportion to the rest. With nothing or no one to check its growth, it ran rampant, causing violation of regulations, numbness of judgment, and willful deceit, and finally led to those fateful words: "We'll make a weather check!"

Adapted from Air Force Systems Command Safety Management Newsletter

pulling circuit breakers

IT IS A WELL-KNOWN fact that the best of business pilots "fly by the book." And to many, that book—the ops manual, company regs, FARs, ATC and approach procedures, etc. — has become a mighty thick compendium. Indeed its mass of rules and their legal implications create an almost rigid environment in which the flight crew must operate. We are told that the reason for this is safety. It leaves the biz pilot scant room for creativity.

Psychologists say that in the selection process, the best pilot candidates come from that group which has little penchant for creativity. If any creativity does exist, it is normally squelched during training.

"Do it the way the book says" is a constant admonition. Recurrent training and the checkrides reinforce this concept. They drive home the point that it is best not to rely on the creative aspect of judgment to solve critical situations in flight. In short, fly by the book — as you've been trained.

This is not a condemnation of "headwork" while flying. It is expected that we will apply previous training and experience to execute continual safe flight, the routine and expected operation of our profession. The pro never experiments while flying, particularly with passengers aboard. He never permits his technical curiosity to get the better of him while in the air. He doesn't mess with things he's not thoroughly familiar with. He believes: "If you don't know what it does, don't fool with it."

But such was not the case revealed in a recent accident report issued by the National Transportation Safety Board. A DC-10 experienced an overspeed condition in its No. 3 engine while cruising at 39,000 feet near Albuquerque. This caused the fan section of the CF6-6D turbo-fan engine to disintegrate, spewing fragments into the fuselage and into the Nos. 1 and 2 engine nacelles and the right wing area. The resultant damage caused decompression of the cabin and loss of certain electrical and hydraulic services.

The captain explained: "The flight engineer and I were speculating about where the automatic throttle system gets its various inputs — whether, for example, from the tachometer itself, the N_2 tachometer, or from the tachometer generator. . .I allowed the airspeed to stabilize at the preselected 257 knots IAS and then selectively pulled the N_1 circuit breakers on the Nos. 1, 2 and 3 engines. . .I merely wanted to check and see if the throttle followed the bug speed. . .I reached in and disengaged the autothrottles and turned to the engineer and remarked to him that I was satisfied with this functioning — and at that point the explosion took place."

In its findings, the NTSB observed that the captain and flight crew were, in effect, performing an *untested failure analysis* on the autothrottle system. The safety board stressed that the operator and the pilot-in-command should be fully cognizant of their operational responsibilities to conduct the flight in a professional manner and not to conduct experiments with aircraft systems in which they have not received specific training or instruction. In other words, *if you don't know what it does, don't fool with it!*

ADDITIONAL SKILL IDENTIFIER (ASI)

"A2, Aviation Safety" Established for NCOs

Effective 1 March 1976, graduates of the USAAAVS Aviation Accident Prevention Management Course for NCOs (AAPMC) conducted at Fort Rucker, AL, will be awarded the Additional Skill Identifier "A2, Aviation Safety," per Change 5 to AR 611-201.

The ASI pertains directly to personnel possessing MOS 67N40, 67U40, 67V40, 67Y40, 67Z50 and 71P series MOS.

Personnel in the above MOS who have attended the USAAAVS two-week resident AAPMC since 17 July 1973 are encouraged to have their records annotated by presenting their diploma to their respective personnel activities.

Commanders are reminded that the AAPMC is available to all personnel possessing an aviation-related MOS. Remember, the 67N20 you have today may be your 67N40 tomorrow.

Passengers should be briefed on the hazards of helicopter operations long before they get near the aircraft

UNQUALIFIED PASSENGERS

NO DOUBT YOU have heard of aircraft accidents occurring because the pilots weren't current or were not qualified in the type or series aircraft they were flying. But have you ever heard of unqualified passengers causing or contributing to aircraft accidents? That's right. Unqualified, not unauthorized. If you don't know what an unqualified passenger is, read on.

A VIP was picked up by a helicopter at a local airport. He fastened his seatbelt and the pilot took off. Shortly after takeoff, the aircraft crashed in rough terrain. The pilot was killed but the VIP and copilot escaped with minor injuries. Cause—unqualified passenger. The VIP's briefcase was on the floor by his feet. It tumbled out an open door and hit the tail rotor.

A UH-1 pilot was assigned a daily mission which required that he fly over water a good deal of his time. He was not a strong swimmer and therefore paid special attention to overwater survival gear. He performed periodic inspections to ensure that the flotation gear would function if the need ever arose and sure enough, the need arose. The UH-1 lost engine power and went down in a lake. Forward speed and attitude were such that the aircraft flipped over on impact. The pilot was knocked unconscious temporarily. Fortunately for him, the copilot was able to get him out before the aircraft sank. Two passengers were thrown clear and both of them drowned because neither could swim. The injured pilot told the copilot to find the flotation gear and he returned to the

Arnold R. Lambert
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aircraft and got it. Contributing cause—unqualified passengers. They did not use seatbelts and did not prepare for impact or get survival equipment ready.

A UH-1 landed on a slope to pick up troops during a tactical training mission. The troops approached the aircraft from the high side of the slope. The first soldier to arrive at the aircraft could not hear very well because of engine noise or see very well because of dust and walked into the path of the main rotor. It was a convincing lesson for the troops who followed him. He recovered from the accident but received permanent brain damage. Cause—unqualified passenger.

Most of you know by now what an unqualified passenger is. He is the passenger who has never been briefed about the hazards in and around helicopter operations.

In the first case, the VIP wasn't briefed because the crew assumed he had ridden in helicopters before. Or maybe they didn't brief him because the flight was to be very short. He should have been thoroughly briefed and told to hold the briefcase on his lap.

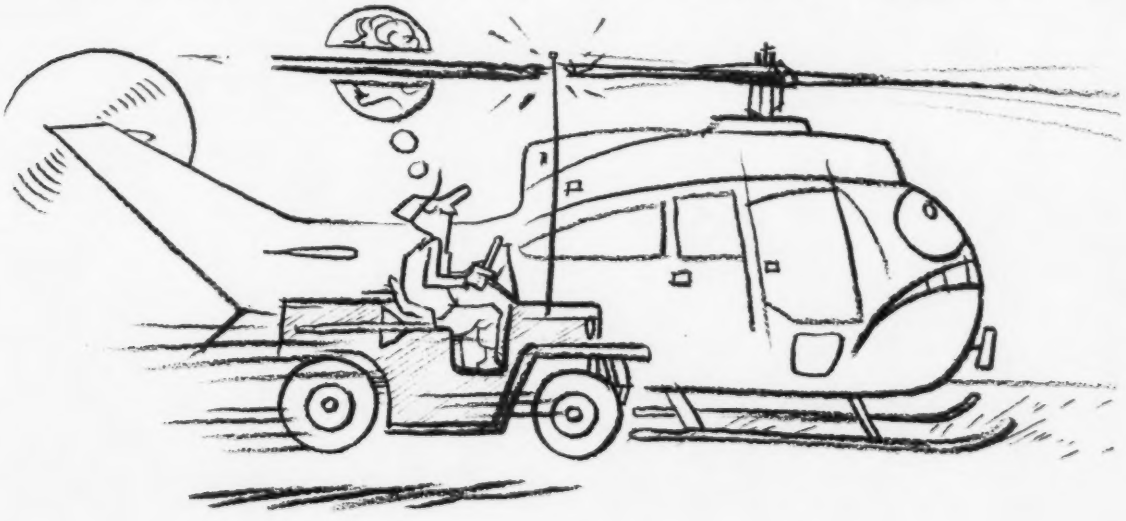
In the second case, the pilot was apparently apprehensive about his swimming ability. This alone should have been good reason for him to thoroughly brief the passengers on the location and general operation of the overwater survival gear. The pilot was fortunate that the copilot had the physical ability to save him and return to the submerged aircraft for the flotation equipment. Had the passengers been briefed before the flight, perhaps they too, would be alive.

In the third case, the troops had not been briefed about the hazards of helicopter operations. The unit commander should have given this briefing before the training mission began.

Nonaviators, usually unqualified passengers, have done some dangerous things around helicopters. Many of them have walked into main and tail rotor blades. Some have been known to grab hold of turning rotor blades or drive shafts. Many have received serious burns from touching hot engine exhaust system components. Radio antennas on ground vehicles and backpacks and tools or other foreign objects have come in contact with rotor blades. Aircraft control interference has been caused by passengers' feet, hands or carry-on gear.

A preliminary briefing should be conducted for people whose duties will require that they work close to or ride in helicopters. The briefing should be conducted before the people ever get close to an aircraft and should include the following:

- The location of the main rotor, the tail rotor and the passenger entrance(s) should be pointed out.
- Always approach the helicopter from the side to



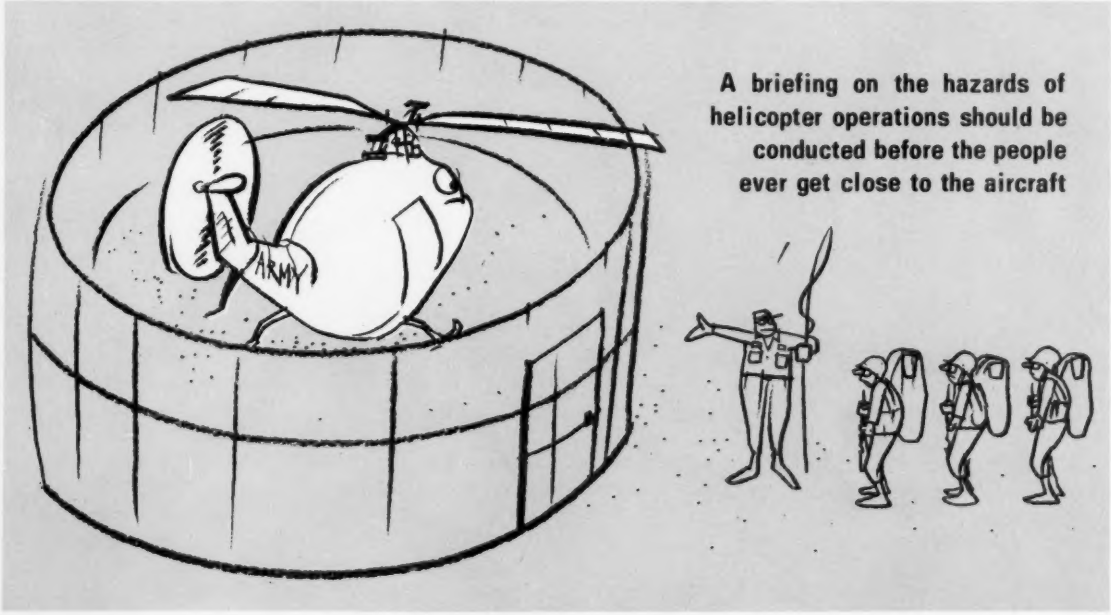
prevent walking into the tail rotor or being scorched by jet exhaust.

- When nearing the swept path of the main rotor, the passenger should always duck down since an inadvertent displacement of the cyclic stick or gusting winds can cause the main rotor to dip a considerable distance.
- Do not lean against or grab any part of the helicopter while approaching the entrance to the aircraft.
- Never grab any control, lever, etc., when stepping up into a helicopter. As a rule, handholds are clearly marked and should be sought out. If you are in doubt, wait for the crew to assist you. The same applies for departing a helicopter.
- Never touch a lever, button, handle, pedal, switch, etc., in flight.

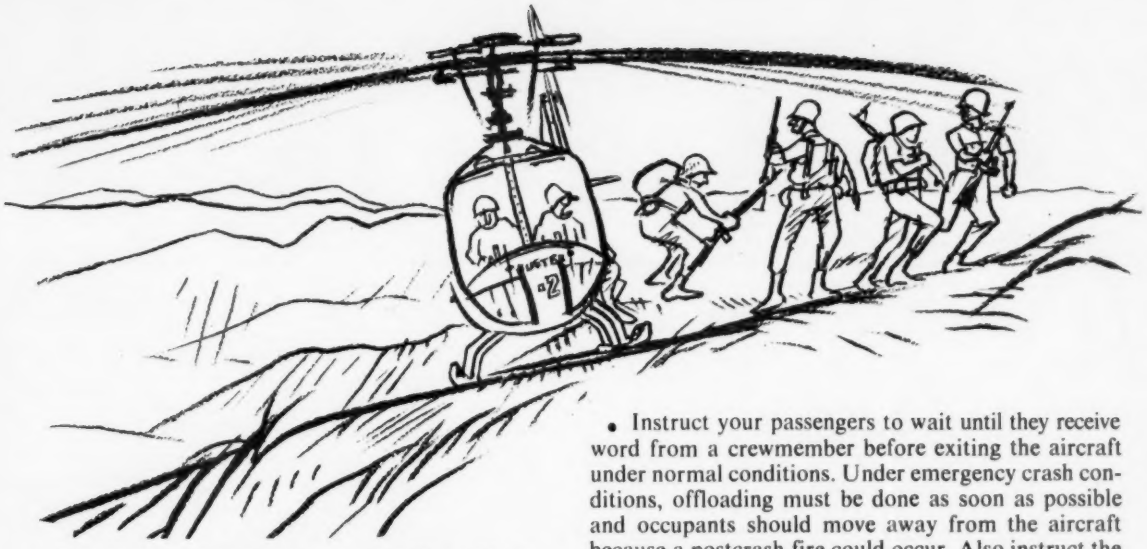
With the preliminary briefing fresh in his mind, the passenger has a good chance of getting aboard the aircraft without any problems. Then he is ready for the flight after he receives his passenger briefing. To insure he gets aboard safely, use your crewchief to meet the passenger beyond the tip path plane of the aircraft and personally guide him to his seat.

If it is your duty to brief people to qualify them as helicopter passengers, following are points which should be covered:

- Inform passengers of route and duration of flight and expected weather conditions. Whenever possible show them the route on a map and if time permits, show them some landmarks.
- When passengers occupy seats from which they can contact aircraft controls, caution them about the danger of the slightest interference with controls.
- Be sure all passengers are aware of smoking restrictions within 50 feet of an aircraft on the ground; during ground operations, takeoffs, landings, and refueling; when oxygen is in use; where fumes are detected; and when an emergency is in progress.
- Inform passengers of all exits and demonstrate the operation of doors and escape hatches.
- Familiarize each passenger with the use and operation of safety belts. Be sure they understand that belts must be used during takeoffs and landings and any other time the pilot directs.
- If helmets are available, stress that they must be worn with chinstrap fastened.
- Brief passengers on location and operation of fire extinguishers. Inform them of the location of the first aid kit.
- If part of the flight is to be over water, provide all passengers with information concerning location and operation of all flotation and life support equipment. Also inform them of the methods of egress from the aircraft after water contact. Warn them about the turning rotor on a sinking helicopter.



A briefing on the hazards of helicopter operations should be conducted before the people ever get close to the aircraft



• Ensure that all passengers are familiar with the location and operation of survival equipment, e.g., flares, radio, etc.

• Tell all passengers that shirt sleeves must be down and buttoned during entire flight and gloves must be worn if available. Earplugs or other hearing protectors must be worn by passengers who do not have flight helmets.

• Brief all passengers about restrictions on loaded weapons and explosive devices aboard helicopters.

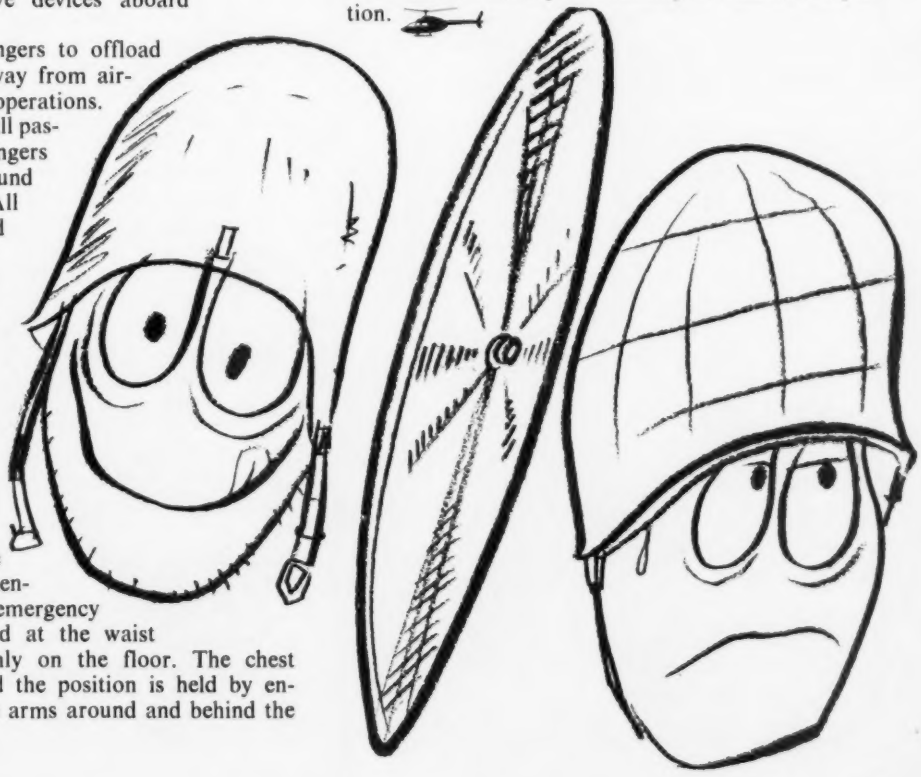
• Instruct all passengers to offload and remain 50 feet away from aircraft during refueling operations.

• Thoroughly brief all passengers about the dangers of loose equipment around and in helicopters. All equipment not attached to or held by a passenger must be secured. Unsecured equipment may become missiles during a crash sequence. Unsecured equipment outside an aircraft may be sucked into the rotor system. Caution passengers never to throw anything from an aircraft.

• Demonstrate the body position all passengers should take for emergency landings. Bend forward at the waist with feet planted firmly on the floor. The chest rests on the knees and the position is held by enfolding and locking the arms around and behind the thighs with the hands.

• Instruct your passengers to wait until they receive word from a crewmember before exiting the aircraft under normal conditions. Under emergency crash conditions, offloading must be done as soon as possible and occupants should move away from the aircraft because a postcrash fire could occur. Also instruct the passengers to assist the injured.

Well informed passengers will lessen the probability of an accident. And in the event an accident occurs, well informed passengers could lessen the severity and increase the chances of survival for all. An accident caused by an unqualified passenger can be just as severe as one caused by an unqualified aviator. Don't fly with unqualified passengers. Brief them thoroughly on all items that may affect safety or mission completion.



briefs that teach

dealer's choice

The mission was designed to give aircrewmembers and ground troops training in proper techniques for night extraction. The mission commander conducted a daytime aerial reconnaissance of the proposed landing zone (LZ) general area the day before the mission. This reconnaissance revealed wires at both the west and east perimeters, but wires within the final approach sector were not sighted.

The two-aircraft lift element departed before first light. The lead UH-1 established radio contact with the troops to be extracted and received the signal for clearance into the LZ. They landed and departed without mishap. The second UH-1 had communication problems with the ground element but received a light signal for clearance into the LZ. The designated LZ was marked by three flashlights provided by the ground troops.

On the initial approach, visual contact with the lights was lost and the crew made a go-around. The same thing happened on the second approach. The copilot then elected to establish a landing to an LZ of his own choice. This decision was discussed with the pilot. Approach was terminated to a hover in an area approximately 762 feet east of the designated LZ. The pilot and copilot decided to "high hover" from the termination point to the designated LZ.

Just east of the designated LZ, the pilot saw wires and alerted the copilot, who responded with a positive downward movement of collective control. The aircraft struck the ground in a slightly nose-high attitude. Acceleration impact speed and movement of collective control in upward motion caused loss of directional control. The pilot took control and lowered collective, and the aircraft settled into a ground depression.

The crew should have initiated go-around procedures and reestablished visual contact with lights marking the designated LZ rather than land to an LZ of their own choice. They elected to proceed with the mission despite the fact that two-way radio communications had failed. These were errors in judgment and poor unit techniques.

Supervision also played a part. Aviators were authorized to conduct support missions without receiving adequate night tactical training or refresher training. Unit policies and local SOPs required only a 1-hour night local orientation flight regardless of individual aviator proficiency.

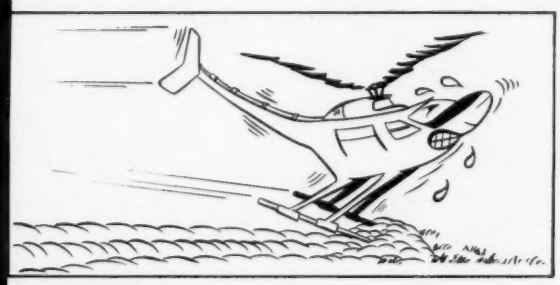
The ground troops were not adequately trained in the responsibilities of lighting the LZ and determining when to give warning signals when aircraft were not landing to desired locations. There was no local SOP covering this.

pilot's discretion

An OH-58 pilot went to a field location to pick up a passenger. After he landed and turned the aircraft around, the passenger entered and strapped himself in. A normal takeoff was made and about 75 feet from the takeoff point, the main rotor struck a pine tree to the right of the flight path.

This pilot was faced with a situation in a confined area where, instead of executing a confined area departure, he elected to make a normal takeoff. The investigation board felt the following factors contributed to the mishap:

- While receiving local transition into the OH-58A, the pilot did not receive any instructions on confined area operations. Numerous other pilots in the unit did not receive formal instructions on confined area operations.
- During the pilot's transition checkride, no mention was made of confined areas, nor was a confined area operation conducted.
- Six months later, during the pilot's standardization ride, confined area operations were not executed.
- The unit's standard operating procedures were also lacking in this area. The unit SOP devoted a single paragraph to confined area operations, finally stating that entry into the area is left to the pilot's discretion. Also, there were no measures taken to ensure that the pilots read the unit SOP.



sodbuster

The flight was a currency checkride. A local flight plan was filed with operations and telephoned to ops at a nearby Air Force base. After clearance from the tower was obtained, the OH-58 was hovered to the sod parallel to the takeoff/landing runway. Various maneuvers were executed, using closed traffic.

The tower then told the crew that fixed wing traffic would be diverted to that runway and requested that the helicopter move to the sod area parallel to a cross runway. The crew complied and began operating in closed left traffic to the designated area. After completing several maneuvers, the crew initiated a right pedal simulated antitorque failure. On final approach, the IP set up the simulated condition and the pilot was executing the maneuver. The aircraft touched down, skidded forward approximately two skid lengths and tipped up on its nose in an extreme attitude. Corrective action resulted in the aircraft becoming airborne. Tail rotor control was apparently lost and the aircraft began a fast spin to the right, crashing after at least one and a half turns. The pilot immediately exited and extracted the IP, who was unconscious.

The primary condition causing the accident was the furrowing action of the landing skids as the helicopter settled onto the soft turf. The thin layer of grassy soil over soft sand was unable to support the weight and normal skidding action of the helicopter as the main rotor blades unloaded. The condition was aggravated by the instinctive reaction of one or both of the aviators to correct the extreme nose-low attitude that followed. **Failure to know the soil condition at the site of the accident led the aviators into a situation from which a completely safe recovery was extremely difficult, if not impossible.**

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USAAAVS, Ft. Rucker, AL 36362

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

Heavy Flying Jacket

I need a flight jacket like the one which appeared in the December 1975 ARMY AVIATION DIGEST in a size 40 or medium and a pair of Nomex gloves, size 8½ or 9. I am an Army aviator assigned as Army Attache in Denmark. Can you help me?

Flight clothing and equipment are authorized by CTA 50-900. These items may be procured through the Army organization to which you are assigned. In your case, you must make your needs known to Commander, U. S. Army Element, DIA (DAS), Ft. Meade, MD 20755. The CTA requires that you must not be in a "prohibited to fly" status. The jacket may be found in the CTA on page II-47, line item number L14978, Jacket, Flying Mans: Winter Weight, Type N-2B, NSN 8415-00-270-0366, size medium. The Nomex flight gloves are found on page II-38, line item number J67052, Gloves, Flyers: Nylon Fire Retardant, Type GS/FRP-2. Gloves are not available in half sizes. NSN 8415-00-139-5409 will get you size 8 and NSN 8415-00-139-5410 will get you size 9.

Equipment Procurement

I would like to know how I can get personal equipment and rescue and survival gear.

The type of equipment you want must be authorized by your unit TOE. The TOE, along with the various authorization documents contained in section I of that TOE, lists both the authority for issue and the number of items allowed. Normally, personal equipment, rescue and survival gear can be found in one or more of the following publications:

DA Pam 385-3, Protective Clothing and Equipment
CTA 50-900, Clothing and Individual Equipment
CTA 50-970, Expendable Items

Nomex Headshield

I would like to point out an error in PEARL'S reply to a question on the Nomex headshield which appeared in the December 1975 ARMY AVIATION DIGEST. On 22 August 1975, our unit had an aircraft accident and the aircraft was equipped with the crashworthy fuel system (CWFS). All 10 persons on board survived the accident, with some receiving minor burns and two receiving third-degree burns. But the crew chief is still in the Fort Sam Houston burn unit. Only through immediate rescue efforts by other crews were their lives saved.

I'm sure that the Nomex worn by the crewmembers and the CWFS were also instrumental in saving their lives, but the fact is that people still get burned in survivable crashes. I think you should be a little more thorough in your research and truthful in your articles. Also, perhaps the Nomex flight suit, as it is, is not sufficient protection in postcrash fires.

Thank you for pointing out a very obvious error regarding thermal injuries in the PEARL article "Nomex Headshield." The paragraph pertaining to the CWFS should have read, "In the past four years, there has been one thermal injury *to the face and neck* in the UH-1H without the CWFS and one thermal injury *to the face and neck* in a U-10A without the CWFS."

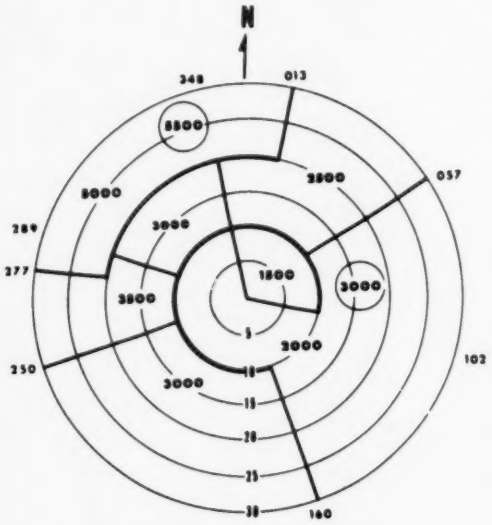
The four thermal injuries which occurred on 22 August 1975 were not yet recorded when the article was prepared early in September. To set the record straight, there are now five individuals who have received thermal injuries in aircraft equipped with the CWFS which were involved in survivable accidents.

True, Nomex does not offer total protection in all cases of postcrash fire. The primary purpose of Nomex is to protect the wearer from flash fires. Nomex chars at about 900 degrees F. and does not support combustion. Non-fire-retardant cotton burns at about 300 degrees F. and will continue to burn. In other words, cotton supports combustion. According to the manufacturer, Nomex can provide 4.6 seconds of protection at 2,500 degrees F. compared to flame-retardant cotton which provides 2.6 seconds of protection.

USAASO Sez

TAKE A MENTAL picture of an example of a radar controller's minimum vectoring altitudes chart.

Minimum vectoring altitudes (MVAs) enable the radar controller to more expeditiously move traffic and provide many services to the pilot. For example, the controller is able to shorten flightpaths and thus conserve fuel by vectoring aircraft on more direct routes where there are no minimum enroute altitudes (MEAs), only MVAs. The controller also has been more effective in assisting aircraft in distress because he can provide minimum altitude information to the pilot who is flying over unfamiliar terrain.



Minimum vectoring altitudes are established for use by ATC (air traffic control) when radar ATC is exercised. MVA charts are prepared by air traffic facilities at locations where there are numerous different minimum IFR (instrument flight rules) altitudes. Each MVA chart has sectors large enough to accommodate vectoring of aircraft within the sector at the MVA. Each sector boundary is at least 3 miles from the obstruction determining the MVA. To avoid a large sector with an excessively high MVA due to an isolated prominent obstruction, the obstruction may be enclosed in a buffer area whose boundaries are at least 3 miles from the obstruction. This is done to facilitate vectoring around the obstruction.

The minimum IFR altitude (this is also the MVA) in each sector is determined by applying the provisions of Federal Aviation Regulation 91.119(a)—1,000 feet or 2,000 feet above obstruction. Where lower MVAs are required in designated mountainous areas to achieve compatibility with terminal routes or to permit vectoring to an instrument approach procedure, 1,000 feet of obstacle clearance may be authorized in lieu of 2,000 feet over towers and/or other manmade obstructions, and 1,700 feet over terrain. Air traffic facilities will establish a higher MVA whenever the minimum IFR altitude does not provide at least 300 feet above the floor of controlled airspace.

Because of differences in the areas considered for MVA and those applied to other minimum altitudes, and the ability to isolate specific obstacles, some MVAs may be lower than the non-radar MEAs/MOCAs (minimum obstruction clearance altitudes) or other minimum altitudes depicted on charts for a given location. While being vectored, IFR altitude assignments by ATC will be at or above the MVA.

If the assigned altitude picture ever gets fuzzy when being vectored, ask the controller to confirm your assigned altitude or the MVA for the area you're in.

A development program is under study which may result in depicting MVA data on approach charts for direct confirmation by pilots.

FEEDBACK

TODAY ARMY aviation combat development has focused on the need to prepare airmobile forces for combat operations on high threat battlefields. The complexity of these future battlefields will require multiple solutions to demanding challenges.

As Army aviators each of us has a mutual responsibility to ensure that Army aviation meets these challenges. Just as those associated with Army aviation have developed, tested, perfected and validated the airmobile concept, we now must direct our talents and skills toward perfecting the new concepts, doctrine, tactics and equipment needed to support the Army's mission on the high threat battlefield.

This past year has seen many new developments or changes in the Army aviation community. Hardware, tactics and doctrine have been realigned to meet the high threat environment. The first AH-1 Cobra TOW (tube-launched, optically-tracked, wire-guided) was delivered to Europe; the CH-47 Chinook modernization and Cobra product improvement programs were launched. An entire new family of aviation training manuals reached the field to keep pace with the new doctrine and equipment. In addition, new utility aircraft will replace current lift ships, the advanced attack helicopter will be made available with a full suit of weapons, and aircraft survivability together with staying power will be increased considerably. While Army aviation's mission remains essentially unchanged, its doctrine and hardware will continue to evolve by leaps and bounds.

Innovations in Army aviation are not overnight occurrences. They are the result of extensive study and evaluation of real problems conducted by various agencies and units in the field. If Army aviation is to be employed successfully in the high threat environment, a constant exchange of ideas and philosophies must be maintained so that new doctrine, concepts and equipment can be adopted for the future. The U. S. Army Aviation Center solicits your support and expertise in identifying problem areas that may occur as you incorporate new doctrine and technology into your training programs.

Your interest, enthusiasm and support of the Combat Development Aviation Studies Program is vital to our efforts at the Aviation Center. Comments and recommendations for studies should be forwarded directly to the Commander, U. S. Army Aviation Center, ATTN: ATZQ-CD, Fort Rucker, AL 36362.

WILLIAM R. PONDER
Colonel, Armor
Deputy for Combat Developments

THESE WORDS OF Thomas Paine, spoken 200 years ago, certainly apply to today's job of aviation accident prevention. It would be impossible to pinpoint just how many mishaps are caused by complacency, by not "thinking a thing wrong." Yet we at USAAAVS have identified complacency as a cause in enough mishaps to know it is a problem.

Too many times aviation personnel fail to suspect that something is wrong . . . they don't check every detail of their jobs. They get away with doing less than their best time after time and come to believe their way is the right way.

The same is true of some supervisors. A declining accident rate contributes to their complacency. They are lulled into a false sense of security until a mishap shows them something's wrong.

Safety is first a state of mind, then a state of being. The constant seeking out of the "things wrong" produces an accident prevention program that is more than skin deep.

THOMAS PAINE

"...not thinking a thing wrong gives it a superficial appearance of being right..."

Make Aviation Safety THE SPIRIT OF '76

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